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SAMPLING AND ANALYSIS PLAN

REMEDIAL INVESTIGATION
RICHARDSON FLAT

Site ID Number : UT980952840

January 9, 2001

Prepared for:

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Mr. Jim Christiansen
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Region 8
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Denver, CO 80202-2466

RE: United Park City Mines response to EPA comments on October 24, 2000 Draft Sampling and Analysis Plan (SAP) for Richardson Flats RI/FS.

Dear Mr. Christiansen:

United Park City Mines is providing a response to EPA comments regarding the October 24, 2000 Draft Sampling and Analysis Plan (SAP) for Richardson Flats RI/FS. A response to each comment is provided directly preceding the original comment provided by the EPA. UPCM is following the numbering system outlined in the EPA response letter. Multiple comment numbers have not been modified, UPCM has included the original EPA comments for clarity.

General Comments

1. The title of the document should be changed to reflect the purpose of this sampling event. The current title is too general, as additional SAP's or addendums to support different aspects of the RI/FS are likely in the future. We suggest "(Draft) Sampling and Analysis Plan, Remedial Investigation, Richardson Flat." Also, at this point in the RI process, it is very likely that additional RI data collection not discussed in the SAP will occur later. It should be made very clear to the outside reader that this SAP covers only specific data collection activities which are scoped at this time and additional data collection will occur in the future, primarily to support risk assessment activities.

- ➢ The title of the document has been changed to "(Draft) Sampling and Analysis Plan, Remedial Investigation, Richardson Flat" as per the suggestion of the EPA. The change has been noted on the title page of the SAP.

2. The primary purpose of any remedial investigation (RI) is to define the nature and extent of contamination and to estimate the degree of risk posed to human health and the environment. The introductory sections of the SAP (Section 2.2) should make these general points clear and should build the foundation for more detailed objectives later in the document (Section 2.3). For this type of sampling event, the reader should be able to be trace *every* sample back to a detailed objective which supports one of those two basic objectives.

- ➢ Section 2.2 has been revised to include general goals of the sampling program. Detailed objectives are presented in Section 2.3.

3. Most of the sampling in an RI is risk-based. That is, the primary purpose is to determine if the site is presenting unacceptable risk and, further, what contaminants, media, and areas are presenting the risk. This initial round of sampling proposed by UPCM is no exception, though it focuses primarily on human health concerns. For this type of sampling, development of a site conceptual model during planning is critical. A site conceptual model and text describing its development and use are missing from the draft SAP. In EPA's comment letter on UPCM's draft RI/FS work plan (November 19, 1999), Item 12 specifically recommended the development of a site conceptual model, in conjunction with the EPA toxicologist, prior to development of a sampling plan.

A site conceptual model utilizes existing information to show: (1) what general contaminants are present, (2) what media they are present in, (3) release mechanisms for the contaminants (actual or potential), (4) potential pathways for exposure, and *(5)* potential receptors which could be exposed to the contamination based on current and future land use. Separate models are sometimes prepared for human and ecological receptors, depending upon the complexity of the site. Through a rational presentation and discussion of all of this information (usually graphically with supporting text), data gaps can be distinguished and data collection needs are made clear. This translates into detailed sampling objectives (Section 2.3). As the investigation progresses, the model is refined until an accurate estimate of risk is achieved. Such models make data collection rationale simpler and data collection more efficient and complete.

In the EPA-approved RI/FS Work Plan (September 2000) for the RI/FS, UPCM developed and discussed a "preliminary site model." More information is included in this SAP. This preliminary site model can form much of the basis for parts of the risk-based site conceptual model(s), but it is not a complete risk-based model. The primary EPA site toxicologist, Dr. Susan Griffin, is also available to provide guidance and assistance.

- ➢ A Site Conceptual Model (CSM) has been prepared, Section 2.3 discusses the CSM and Figures 8a and 8b graphically portray the CSM and its' relationship to the site.

4. Overall, the development of the sampling program in the SAP should proceed this way:

(1) Presentation of the general goals for this sampling event
(2) Presentation and discussion of existing information on the site
(3) Use of that existing information to develop a site conceptual model
(4) Use of the site model to identify data gaps, clear objectives, and decision points
(5) Use of the seven step DQO process to identify a sampling program to meet those objectives, identify any decisions to be made, and how those decisions will be made. Information on the DQO process and its use can be found in EPA QA/G-4 (August 2000). Following the DQO process is critical to ensure data collected is adequate and sufficient.

- ➢ See Sections 2.2 and 2.3.

5. It appears that many of the samples proposed by UPCM are intended to address both human health and ecological concerns. For instance, site boundary delineation applies to any receptor. However, as we have discussed numerous times, EPA has insufficient information compiled at this point to offer specific guidance for collection of ecological-risk

based data. I have proposed technical assistance meetings beginning this winter to begin addressing ecological data collection process. Therefor; review of this SAP focused on human health concerns which are more defined at this point. Wherever possible, limited guidance or recommendations regarding ecological risk are made, generally to try to limit the need for redundant data collection in the future.

- UPCM recognizes the need for additional ecological data and is cooperatively working with EPA's ecological risk assessor to determine the scope of additional data collection for ecological risk analyses.

6. The SAP is generally weak in the area of data review and assessment. Specific comments are provided below for the relevant sections. The SAP also did not include all of the areas recommended in EPA QA/R-5 (November 1999). These include Special Training/Certification (A8), Documents and Records (A9), Instrument Equipment Testing, Inspection and Maintenance (B6), and Data Management (B 10). Note that these sections do not necessarily have to be extensive (and are not required in EPA Region 8), but should be sufficient in detail to address the problem and to provide evidence that a process is in place prior to project implementation - a particular concern is data management. In some cases, only a sentence or two should suffice.

- Additional language has been added to strengthen the sections on data review and assessment. Specific comments have been addressed. Sections addressing A8, A9, B6 and B10 have been added, although since these sections are not required in EPA Region 8 they are brief.

Specific Comments

6. Section 2.0. Please include a distribution list of individuals and their organization who will receive copies of the approved SAP and any subsequent revisions.

- A distribution list has been added to Section 2.0 of the SAP.

7. Section 2.1. The UDEQ, DERR project manager is Muhammad Slam. Also, the oversight role of EPA and UDEQ should be discussed.

- The UDERR and EPA Project Managers shall work cooperatively to oversee the work being performed at the Richardson Flat site. This is addressed in Section 2.1 of the SAP.

8. Section 2.2, Page 5, last paragraph. EPA and UDEQ recognize that UPCM feels strongly that no further remedial measures are necessary at this site. This is reflected in language included in the RI/FS Work Plan. However, in the SAP, we feel there is no need for this long section early in the document which virtually reiterates the same language from the Work Plan. It would be more appropriate, and more effective, to identify actions taken voluntarily by UPCM, and then to evaluate existing site conditions (including past UPCM mitigative work) in terms of a risk-based conceptual site model rather than generally in the beginning of the document. If indeed past work has mitigated risk, it will be reflected in the conceptual site model.

➢ Voluntary remedial measures performed by UPCM have been detailed in Section 2.2.

9. Section 2.2.1, Page 7, 1st paragraph. See general comment #3 above for discussion on "preliminary site model" presented in the RI/FS Work Plan and the need for a conceptual site model as a foundation of this SAP.

➢ See response to comment #3.

10. Section 2.2.1.1, Page 7. Please clarify if ALL tailings have been covered.

➢ Wording has been added to clarify that all exposed tailings have been covered as part of voluntary remedial measures.

11. Section 2.2.1.2, Page 8. This section states that "If the data do not meet QA/QC goals the data will be used to guide decisions based on a qualitative basis." Data that does not meet QA/QC requirements should not be used for decision making. EPA suggests the statement be revised to read: "If the data do not meet the QA/QC goals, the data will not be used in decision making directly. Rather, these data will be used to optimize the data gathering process and additional data points that meet QA/QC requirements will be collected and used for decision making."

➢ The wording of Section 2.2.1.2 has been modified to reflect the wording suggested by the EPA.

12. Section 2.3, Page 13. As discussed in general comment #3 above, the objectives of the sampling plan are too generic. From our past conversations, I am sure that you are not attempting to get all of the data UPCM or EPA/UDEQ will need to make decisions on this site through this single event. Therefore, it needs to be very clear which objectives you are attempting to meet so we can evaluate the adequacy of this plan. These objectives should stem primarily from the conceptual site model and one/both of the two primary objectives discussed in general comment #2 above. Only when objectives are clear and specific can EPA determine if the
sampling locations & method, frequency, detection limit, etc. will meet those objectives. Based on the understanding I have on what you are trying to achieve, *example* objectives might include:

For soils & tailings:

- Determine the level of contaminants in imported impoundment cover soils. Provide data of sufficient quality and quantity for analyzing an health and for comparison with ecological screening levels and background. Verify depth of imported impoundment cover.

- Screen for impacts to off-impoundment soils and delineate the site boundary. Delineate all areas of potential impacts through the use of human and ecological soil screening levels.

- Collect data on composition and chemical qualities of tailings to evaluate their long-term fate and chemical stability.

For surface water & sediments:

- Collect sediment data in the south diversion ditch to aid in identification of location of metal loading within the ditch. Use data to aid in long-term fate and chemical stability modeling and in ecological risk assessment.]

- Collect data in Silver Creek and in drainages associated with the site to aid in determination of the background water quality relative to the site and the site's impact on water quality in Silver Creek, including seasonal variations. Provide additional surface water data for comparison with human health and ecological screening levels.

For ground water:

- Screen for impacts to shallow alluvial ground water associated with Silver Creek.

- Collect data to investigate the interaction between shallow ground water and Silver Creek, including seasonal variations.

➢ A detailed list of goals and objectives were added to Sections 2.2 and 2.3.

12. Section 2.4. The bullets in this section define the difference between screening data and definitive data. A couple of important components that distinguish definitive from screening data are not adequately captured. First, in order to be used in the decision-making process, screening data must be confirmed via a method that generates definitive data. As currently written, the SAP does not identify data generation techniques that fall into the screening data category; therefore, definitive confirmation is not required. Secondly, definitive data may be generated <u>at the site</u> or <u>an off-site location</u> (EPA Superfund Data Categories, September 1993). Therefore, pH data and water level measurements may be considered definitive for their intended uses, providing sufficient evidence exists to demonstrate that procedures were followed and data were generated and documented in accord with project requirements. It is recommended that both bullets, defining screening and definitive data, be removed from the SAP. The SAP should require sufficient QA/QC to ensure that all data collected for this project and used in decision-making are definitive in nature.

Similarly, the section states that "All data collected during the RI/FS, except for decontamination water samples collected for pH testing in the field, will be considered "definitive"..." This statement is an important one, but should be revised to read as follows: "All data generated during the RI/FS is intended to be collected for use in site characterization and risk assessment; therefore, definitive data (data of known quality) are required for all aspects of this project."

➢ Suggested changes made.

13. Section 3.0. Many of the proposed sampling events discussed in the Work Plan and presented in the SAP are intended to *screen* for impacts. If there are no unacceptable impacts (for example below screening levels or at background levels), then no further sampling will be necessary. However, if impacts are found, additional sampling *may* be needed to completely characterize risks to human health or the environment. This depends

on factors such as nature and extent of contamination, land use, and potential ecological concerns we have not yet discussed in any detail. This is particularly true for off-impoundment soil sampling and should clearly be reflected through the DQO process.

- Section 3.0 has been modified to reflect that additional sampling may be required.

14. Section 3.0. An important screening criteria for any media is background. Additional discussion on background needs to be included in the document. The text mentions that one "background" soil sample was collected in 1984. Unless additional and adequate historical data are available, this is a significant data gap which needs to be addressed in this SAP.

- Twenty-five (25) background sample locations will be collected in an area surrounding the site. Details for the collection of background samples are presented in Sections 3.1.6 and 3.2.5. Background Sample locations are shown on Figure 2.

15. Section 3.0. Along the lines of a conceptual model and clear objectives, it would be helpful to present a table which summarizes the specifics and purpose for each sample set (corresponding to Sections in 3.1). This could be an expansion of Table 5. Suggested headings include: Media; Objective; Location, Analytes.

- Table 5 was modified as per the EPA suggestions. Table 1 was also modified to reflect the goals and needs of the conceptual site model.

16. Section 3.1.1. The SAP did not address the small pond located on the west side of the tailings impoundment. Is sampling contemplated for this area under this SAP?

- Sampling is not planned specifically for the pond. Water quality samples are collected both upstream and downstream in the diversion ditch, which flows into the pond. Additional samples in the pond itself will add little if any information.

17. Section 3.1.2. Please clearly state the name of the proposed ground water monitoring wells so they can be more easily identified on Figure 4. Also, clearly state if ground water samples with be analyzed for total and/or dissolved metals.

- The wells have been named RT-11 and RT-12 and are discussed in detail in Section 3.1.2. The location of the wells is provided on Figure 4.

18. Section 3.1.3. UPCM has proposed a "screening" criteria for cover soils of 500 ppm lead and 250 ppm arsenic. If levels in soil exceed those amounts, additional analysis is proposed. There is no rationale in the SAP to explain or support these screening criteria. We understand is an attempt to reduce sampling costs, and that for mining sites, lead and arsenic are, frequently the primary metals of concern regarding human health. However, the choice of lead and arsenic as "screening contaminants" and the associated levels are arbitrary at this point and should not be used as proposed at this point in the investigation.

An alternative approach should be proposed, one that considers all potential site contaminants initially. We cannot recommend an alternate procedure/screening rationale without first defining the full objectives of the impoundment sampling. For instance, does

UPCM intend to use this sampling to screen for potential ecological impacts due to cover soils?

- Section 3.1.3 details that all samples will be analyzed for lead and arsenic and 20% of all surface samples collected will be analyzed for RCRA metals including copper and zinc. The "screening levels" have been removed from the text.

19. Section 3.1.3, Soils Cover Sampling. Off-site soil sampling (wind blown tailings) is discussed in this section, though it has nothing to do with the impoundment cover. Please revise the title of this section or make a separate section to discuss off-site soil sampling.

- Section 3.1.3.1 was added to detail the off-site soil sampling as a separate phase of the project.

20. Section 3 1.3 and Associated Soil Sampling SOP. For human health risk assessment purposes, current EPA policy and guidance requires bulk soil samples be sieved to <250 microns. The <250 micron fraction is then analyzed for metals. If these samples are intended to be used for human health risk assessment purposes, this protocol should be followed. For ecological screening/risk assessment purposes, sieving should not occur.

- Section 3.2.3 details the procedure for soils sampling. Surface soil samples (samples collected at a depth of 0-2") collected for human health risk assessment purposes will be submitted as bulk samples to the laboratory. The laboratory will split the sample into two equal portions. One sample will be archived by the laboratory. The second half of the bulk sample will be sieved as per current EPA policy and guidance to <250 microns. The <250 micron fraction is then analyzed for human health risk assessment purposes.

21. Section 3.1.4. All soil and sediment samples should be analyzed on a dry weight basis.

- Section 3.2.3 was modified to state that all soil and sediment samples should be analyzed on a dry weight basis.

22. Section 3.1.5. It is recommended that a backhoe not be used due to the substantial disturbance and mixing that may occur. Also, for off-impoundment tailings, UPCM proposes to install monitoring wells ONLY if ground water is encountered during investigation. Ground water levels vary over time, and may not be present at the time sampling occurs, but be present at other times. Please address.

- Section 3.1.5 has been modified to address the reasoning why a backhoe will be used to maximize visual observations of tailings, soils and the tailings/soils interface as well as maximize sample quantities. The methodology for using a backhoe with minimal disturbance is detailed in the Section 3.1.5.
- Two monitoring wells will be placed to monitor the potential occurrence water in the tailings. Monitoring Wells RT-13 and RT-14 are detailed in Section 3.1.5.1 and are shown on Figure 4.

23. Section 3.2.3.2. This section notes that samples will be collected in a "plastic bag." This is inconsistent with Table 2 which specifies a "glass jar" will be used.

➢ Section 3.2.3.2 and Table 2 have been modified to describe sample containers as glass jars or plastic bags.

24. Section 3.5. If field equipment is decontaminated on site or used at different locations, equipment rinsate blanks should be collected.

➢ Section 3.5 has been modified to detail the collection of rinsate blanks.

25. Section 4.1, Assessments and Response Actions (C1). This section is quite brief and does not adequately include all the components required in the EPA guidance. According to EPA QA/R-5, this section should provide detail on assessments to be employed during the project. Assessments can and often should occur during the sampling and data acquisition phases of the project. They provide a proactive means for assessing the processes and procedures employed during data generation allowing for sufficient time to make corrections, if necessary. Assessments can be in the form of field and/or laboratory technical systems audits, data quality audits or validation, and performance evaluations, among others. In addition to describing the type(s) of assessments that will be used, this section should also provide: the planned frequency for each proposed assessment; the personnel and/or agency responsible for the assessment activity; and the corrective action procedures for each assessment. Using EPA QA/R-5 as a guide, describe what type and frequency of assessments are planned. Also, ensure that UDEQ is also listed as a recipient of deliverables (page 27).

➢ Descriptions of specific assessment steps that will be performed during the project have been included in Section 4.1.

26. Section 5.1, Data Review, Validation and Verification Requirements (Dl). This section indicates that the requirements and methods for data validation and verification are listed in Tables 3 and 4. EPA agrees that use of the tables is a convenient way to supply data verification components; however, these tables should be refined to include additional information. Comments pertaining to these tables are provided below.

<u>*Table 3*</u>

- QC samples. To be complete, PARCC components for laboratory QC samples should also be included (e.g., instrument blanks, laboratory method duplicates, post-digestion spikes). If a table is prepared similar to the one provided in Attachment A, all pertinent QC criteria and corrective action will be addressed in a single table. Provide the laboratory control limits for both the matrix spikes and laboratory control samples in the next revision. The "Summary of QA/QC Goals" can then be removed from this table.

➢ Table 3 revised to clarify acceptance criteria and include corrective actions. Refer to the method-specific SOPs (Appendix F) for laboratory control limits and corrective actions specific to each method.

- Precision. Under Evaluation Criteria: replace "reproducibility" with RPD for the matrix spike/matrix spike duplicate pair.

➢ Suggested change made.

- Accuracy. Under QC Program: Please clarify what Lab-Specified Historical limits are and how they are used.

➢ Reference to lab-specified historical limits deleted.

- Comparability. Under QC Program: Remove Field Duplicate Pairs.

➢ Suggested change made.

- Completeness. Under Evaluation Criteria: Provide a definition for "valid".

➢ "Valid" defined in the footnotes of Table 3.

Table 4
The information contain in this table is a summary of activities that should occur when assessing the data. As stated previously, it does not provide sufficient detail to perform a validation or verification and then assign data qualifiers as a result of that review.

➢ The text references the *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (EPA, 1994) for validation methods. Tables 4b and 4c have been added to provide sufficient detail to assign data qualifiers as needed.

27. Section 5.2, Validation and Verification Methods (D2). This section states that data validation and verification will be conducted on a minimum of 90% of samples. However, this statement is vague in three important areas: a) definitions of validation and verification; b) rationale for application of the 90% rate for validation and verification; and c) steps used for data qualification during validation and verification.

A) For your convenience, Superfund's working definitions for data validation and verification are provided below:

Data Verification: A consistent, systematic process that determines whether the data have been collected in accordance to the specification as listed in the contract requirements included within the approved Quality Assurance Project Plan (QAPP). This process is independent of data validation and is conducted at various levels both internal and external to the data generator (laboratory).

Data Validation: An evaluation of the technical usability of the verified data with respect to planned objectives. Data validation is performed external to the data generator (laboratory), using a defined set of performance criteria to a body of data in the evaluation process. This may include checks on some or all of the calculations in the data set and reconstruction of some or all final reported data from initial laboratory data (e.g. chromatograms, instrument printouts). It is in the data validation process that data qualifiers for each verified data are evaluated. It extends beyond the analytical method or contractual compliance to protocols or QAPPs to address the overall technical usability of the generated data.

➢ Definitions added.

B) This section should indicate whether the rate of 90% applies to both verification and validation or if different fractions of data will be verified and validated. It is common for 100% of the data to be verified both internally at the analytical laboratory and externally by independent reviewers. Independent reviews may be UPCM or a subcontractor experienced in this type of review. Chemical data validation is quite labor intensive and must be performed by a chemist experienced in the data validation and qualification process. Because of this, generally 10% of the data are validated. If problems are uncovered as a result of the validation effort, an outline for handling the further reviews must also be included in this section.

➢ One hundred percent of the data will be verified and validated in accordance with the steps listed in Table 4 (i.e., "Level III validation").

C) This section states "The degree of sample deviation beyond acceptance limits will be evaluated for its potential effect on data usability." EPA agrees that an assessment of data usability must be performed for data generated for this project. The QAPP must define an objective approach for how data are assessed. The data validation effort typically uses *National Functional Guidelines for Data Review* (Inorganic & Organic: February, 1994) to assign application of data quality indicators, if specific qualification requirements are not identified in the QAPP.

➢ The text references the *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (EPA, 1994) for assigning data quality indicators.

28. Figure 1- Richardson Flat RI/FS Organizational Chart. As presented, the organizational chart is misleading at the level of State and Federal agency oversight. The EPA Project Coordinator and the UDERR Project Manager work cooperatively to oversee the work being performed at the Richardson Flat site. The chart should be modified such that it does not appear that Mr. Christiansen oversees work performed by Mr. Thiriot (should be Mr. Slam); but rather, they both oversee work performed by UPCM and its subcontractors. In addition, the organizational chart identifies the ASARCO/AEC laboratory for sample analysis. However, based upon the chart, we are unsure how Frontier Geosciences, Inc. fits into the organizational scheme. Because a Laboratory Quality Assurance Plan (LQAP) was provided in Attachment 12 of the ASARCO/AEC Quality Assurance Manual, we assume that Frontier Geosciences will perform a portion of the analytical work. Please clarify the relationship with Frontier Geosciences as it relates to ASARCO/AEC and the project as a whole.

➢ Figure 1 has been modified as per the EPA suggestions.

29. Table 2. Laboratory Reporting Limits are summarized in Table 1. However, the

rationale supporting these values as they relate to project requirements is not provided. Identifying the minimum concentration that each target analyte must be detected is a key component of the DQO process. This step ensures that RLs are sufficient to support end use purposes (e.g., risk assessment). Project-required detection limits are typically established as a combination of methods which may include (depending on site-specific conceptual site model): 1) using screening-level values from the Region Ill Risk-Based Concentration Table or calculated site-specific values; 2) Safe Drinking Water Act Maximum Contaminant Level criteria; 3) Ambient Water Quality Criteria; 40 background, or 5) other State or Federal regulations. The LQAP provides a list of total metals method detection limits for ICP Methods 6010B/200.7 and 6020/200.8 updated in 1998. A comparison between project requirements and laboratory capabilities must be performed to determine if the selected laboratories are able to meet project requirements or if LRL requirements may be relaxed.

➢ Based on a comparison to chronic and acute aquatic wildlife criteria and drinking water standards, the proposed LRLs listed in Table 2 for metals analyses of water samples are generally at or below the standards. Proposed LRLs for soil and sediment samples are below typical cleanup goals for metals. Table 2b has been added to compare applicable criteria to proposed laboratory reporting limits (LRLs).

30. Table 2. Provide rationale explaining why both ICP and ICP/MS methods are recommended for metals analysis of each sample. Both ICP and ICP/MS methods are capable of performing a metals scan that provides the results for all metals on the parameter list with the exception of mercury. Therefore, analytical effort may be conserved if only one method is selected. Development of project-required detection limits will also help to determine whether one or both of these methods are necessary.

➢ Water samples will be run through both ICP and ICP/MS instruments. The data that applies best to the concentration range measured will be used. The lab uses this approach to avoid the need for repeated dilutions.

31. Table 2. This is a nice summary of project requirements, but please revise the table to improve accuracy as follows:

- Change "polyurethane" to "polyethylene".
- Soil holding time of 180 days for chromium must be added.
- Cite Preservative for all metals in water as "2 ml HNO_3 (pH<2)"
- Clarify the units in the LRL column. For example, identify which rows have units of ppm, which are ppm based upon dry weight, and the units for conductivity.
- To ensure that solid samples may be reported on a dry weight basis, add percent moisture to the parameter list.
- Provide the reference for hardness method (e.g. Standard Methods, 20th ed.)
- Change the holding time for hardness to 180 days, since it is a calculation that uses calcium and magnesium results measured by ICP.
- Reference pH method as EPA 150.1.
- Change the analytical method for sulfate from SW-846 9036 to EPA 375.2 and change preservative and/or bottle selection accordingly.
- It is not necessary to collect an additional bottle (Bottle 3) for calcium, potassium,

magnesium, and sodium. These parameters are captured during the 6010 or 6020 metals scan.

- Change the holding time for carbonate and bicarbonate to 14 days as these parameters are analyzed with alkalinity.
- Change the holding time for sulfate to 28 days.
- Ensure the most recent test method is used. For example, method 6010B should be used instead of method 6010.
- Lastly, at this point it is difficult for EPA to state whether the methods and detection limits proposed are sufficient because of the lack of clear objectives and DQO process in the document.

You may want to consider having the lab measure the temperature of the cooler upon receipt to ensure proper temperature was maintained, especially for mercury. EPA allows a range of temperature of 4°C ± 2°C.

➢ All suggested refinements to Table 2 were made.

32. Standard Operating Procedures (SOPs). The SOPs provided as an attachment to the SAP were reviewed. Several important components appeared to be consistently omitted. Standard Operating Procedures (SOPs) should be written with the understanding that the information contained within them will be used in the field by samplers who may not be familiar with the overall project goals and may have limited experience with the or performance of the activity or procedure. SOPs must be written to serve as a step-by-step guide and must include all steps necessary to complete a procedure from start to finish (including equipment decontamination and field documentation). The EPA has a guidance document available to assist in the development of SOPs: Guidance for the Development of Standard Operating Procedures for Quality-Related Documents EPA QA/G-6 (November 1995). This and other useful quality assurance documents and guidelines are available online at: http://www. epa.gov/rloearth/offices/oealqaindex.htm.

Specific comments on each SOP were not prepared; however, an example of components that should be addressed is provided below for one SOP:

RMC SOP 1

- Sampling Equipment. This section provides a list of equipment needed for surface water sampling. Each item should include a description and/or definition of the item; in cases where the item is optional ("if necessary"), then an explanation of when the item is required should also be included.

- Dissolved Metals and Total Metals Analysis. Both sections state that the samples will be "preserved with 2 ml of NO_3. Please replace "NO_3" with "nitric acid (I-INO_3)". Additionally, these sections state: "...sufficient to bring the sample to pH < 2". Include the following sentence: "The pH level in the samples will be verified using pH paper before bottles are sealed."

- Dissolved Metals Analysis. This section states that "samples will be field filtered". A description of the steps and equipment necessary to perform field filtering must be included in this section.

- Cations/Anions and Total Suspended Solids. Details outlining the steps for collection and preservation of these samples has been omitted and should be included in the next version of the SOP.

- Documentation. A section describing the information that must be recorded in the field notebook and log forms must be incorporated into the next version of the SOP. In addition, this section should reference the sample handling and documentation SOP (RMC SOP 5).

➢ Each SOP was reviewed and modified as per the EPA suggestions.

33. Laboratory Licenses & Laboratory Quality Assurance Plan.

- The environmental laboratory license presented in the QAPP Appendices that was issued to ASARCO/AEC by the Arizona Department of Health Services expired on January 20, 2000. Please provide a copy of the updated license in the next version of the QAPP. Also, is the lab certified by the State of Utah? A Utah certified lab should be used.

➢ The Arizona license is not relevant to this project. A copy of AEC Laboratories Utah certification is now included in Appendix F.

- How are data generated at the ASARCO/AEC lab going to be submitted to UPCM? (Electronically and/or hardcopy?) This information is not contained in the Laboratory Quality Assurance Plan (LQAP). Rather than update the LQAP, UPCM may address this concern in the Data Management section of the SAP.

➢ A new Data Management section has been added to the text (Section 3.7).

- Section VIII Data Reduction, Validation and Reporting, page 9. LQAP contains sections that appear to have been developed solely for a single type of analysis (ICP 6010B) as it provides specific accuracy requirements for this method (e.g., ICV/CCV between 90-110% recovery). While this defect should be corrected in the next edition of the LQAP, EPA considers this a minor problem as other areas of the LQAP (Table: Quality Control Requirements) exhibit an understanding that each analytical method has QC criteria. However, because the LQAP contains inaccurate precision and accuracy requirements and data review and validation procedures, the SAP should specifically state the precision and accuracy requirements and the data review and validation procedures for the methods selected for the project. Additionally, the SAP should include a statement indicating that if contradictions between the various documents are identified, the information contained in the SAP supercedes all other documents.

➢ The laboratory has provided SOPs for each method that include acceptance limits and data review and validation procedures (see Appendix F).

- Holding Times. This LQAP should include a list of specific holding times for the target analytes performed at the laboratory.

➤ See Table 2 for a list of specific holding times.

- Attachment 4, Central Logbook Record. The contents of this attachment are missing.

➤ An example of a central logbook record is now included.

- Attachment 7, Method Detection Limits. This section provides a summary of total metals method detection limits (MDLs) for ICP Methods 6010B/200.7 and 6020/200.8. The units are identified as "ppb". While it is inferred that the MDLs are for water matrix (based upon the cited mercury method reference and levels of detection), this table should be revised to indicate for which sample matrix these detection limits apply. Soil method detection limits are typically 100 times higher than water MDLs; these limits should also be provided in the LQAP. Additionally, analysis of the MDLs occurred in 1998. EPA recommends that MDLs be updated or confirmed a minimum of annually.

➤ Revised MDLs are now included.

- Attachment 12. The LQAP for Frontier Geosciences appears complete, but the certifications are not included as suggested by the list of contents provided on the "Appendices" cover page.

➤ Frontier Geosciences is not currently certified in the State of Utah, but is certified in a number of other states. They are evaluating whether they can become certified in Utah in time for this project.

34. Lastly, the entire document needs a grammar and spell check. Specific examples noted include:

- Page 5. The acronym EPA is not previously defined.
- Page 6. "RI/FS final reports" should be changed to "final RI/FS report."
- Page 11, Section 2.2.1.3. Section is numbered out of sequence.
- Page 14, Section 2.4. Delete "and removal actions" from first sentence.
- Page 15, Section 3.0. 2nd paragraph, 3rd sentence. Replace "will b tied" with "will be tied"
- Page 19, Section 3.1.5. 2nd line, spelling error "long term."
- Page 19, Section 3.1.5. Should read "...down to a depth of 5 feet below the tailings/cover interface."

➤ A detailed spell and grammar check has been performed on the final draft of the document.

United Park City Mines appreciates the comments provided by the EPA. All comments provided by the EPA have been responded to in this letter. The revised SAP attached to this response letter contains the modifications required by the EPA.

Sincerely,

Kerry C. Gee
Vice President
United Park City Mines Company

-DRAFT-

SAMPLING AND ANALYSIS PLAN

REMEDIAL INVESTIGATION
RICHARDSON FLAT

Site ID Number : UT980952840

January 9, 2001

Prepared for:

United Park City Mines Company
P.O. Box 1450
Park City, UT 84060

Prepared by:

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SAMPLING AND ANALYSIS PLAN

REMEDIAL INVESTIGATION
RICHARDSON FLAT

January 9, 2001

Prepared for:

United Park City Mines Company
Park City, UT 84060

Prepared by:	______________________ Jim Fricke Resource Management Consultants	Date:	______________________
Reviewed by:	______________________ Kerry Gee United Park City Mines Company	Date:	______________________
Reviewed by:	______________________ Jim Christiansen USEPS Remedial Project Manager	Date:	______________________

TABLE OF CONTENTS

1.0 INTRODUCTION

This Sampling and Analysis Plan (SAP) addresses the sampling and analysis of surface and ground water, soils, sediment and tailings materials during field activities conducted as part of a focused Remedial Investigation and Feasibility Study (FOCUSED RI/FS) at the Richardson Flat Tailings site (Site) near Park City, Utah. The Site is an inactive mill tailings impoundment owned by United Park City Mines Company (United Park), United Park is conducting the RI/FS pursuant to the Administrative Order on Consent (AOC) for a focused Remedial Investigation/Feasibility Study, dated September 28, 2000, U.S. EPA Docket No. [**CERCLA-8-2000-19**] The focused RI/FS Workplan (RMC, 2000) as referenced in this SAP was approved by the United States Environmental Protection Agency Region VIII (EPA) on September 28, 2000.

This SAP combines the relevant portions of a Field Sampling Plan (FSP) and Quality Assurance Project Plan (QAPP). As requested by EPA, the format of this plan follows the 16 elements of a QAPP as defined in *EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations* (USEPA QA/R-5, 1998a). Section titles are followed by the corresponding QA/R-5 outline numbers in parentheses.

The SAP contains the Health & Safety Plan (HASP) that will be followed during Site activities by all visitors (*See* Appendix A).

This SAP, when necessary, can and may be amended should there be a need to do so. It will also provide procedures for sampling to be conducted as part of EPA oversight of the RI/FS.

2.0 PROJECT MANAGEMENT (A)

This SAP and subsequent revisions will be distributed to the following organizations and individuals:

Jim Christiansen U.S. EPA Region 8 999 18th Street Suite 300 Denver, CO 80202-2466 (2 copies)	Muhammad Slam Utah Division of Environmental Response & Remediation 168 North 1950 West 1st Floor Salt Lake City, UT 84116 (1 copy)
Betty Grizzle U.S. Fish & Wildlife Service Lincoln Plaza Suite 404 145 East 1300 South Salt Lake City, UT 84115 (1 copy)	Kevin Murray LeBoeuf, Lamb, Greene & MacRae 1000 Kearns Building 136 South Main Street Salt Lake City, UT 84101-1685 (1 copy)
Public Repository Park City Library 1255 Park Avenue Park City, UT 84060 (2 copies)	
Resource Management Consultants 8138 South State Street Suite 2a Midvale, UT 84047 (1 copy)	Global Environmental Strategies 5953 South Iola Way Englewood, CO 80111 (1 copy)

2.1 PROJECT/TASK ORGANIZATION (A4)

The RI/FS management team consists of United Park personnel with assistance from Resource Management Consultants (RMC) and other environmental consulting firms as needed. Figure 1 shows the chain-of-command for the project managers, engineers, and quality assurance officials responsible for managing the Richardson Flat Tailings Site FOCUSED RI/FS.

United Park's environmental Project Manager for the Site is Kerry Gee, who will be responsible for all project management and communication with the regulatory agencies. Jim Fricke of RMC, Salt Lake City, Utah, leads United Park's environmental project consultant team and will be the Site Manager, who will be responsible for implementation of the SAP. Todd Leeds, of RMC, is the Field Manager who will be responsible for all field activities related to this document. Wesley McDonald, RMC, is the Site Safety Officer, who will be responsible for visitor sign in and ensure that all site visitors comply with the HASP.

The EPA Project Coordinator is Jim Christiansen, Region VIII, Denver, Colorado. The Utah Department of Environmental Remediation and Response (UDERR) Project Manager is Muhammad Slam. The EPA Project Coordinator and the UDERR Project Manager work cooperatively to oversee the work being performed at the Richardson Flat site.

Mr. Gee, as Project Manager, is responsible for the overall management and coordination of the following activities:

- Coordination with EPA/UDERR regarding the status of the project;
- Providing oversight of the subcontractors;
- Reviewing monthly status reports;
- Supervising production and review of deliverables;
- Tracking work progress against planned budgets and schedules;
- Informing EPA/UDERR of changes in the Workplan, SAP, HASP and/or other project documents;
- Notifying EPA/UDERR immediately of significant problems affecting the quality of data or the ability to meet project objectives;
- Procuring subcontractors to provide sampling and analytical support;
- Providing oversight of report preparation;
- Organizing and conducting a field planning meeting.

Mr. Fricke, as the Site Manager, is responsible for the following:

- Preparing monthly status reports;
- Coordinating with the laboratory regarding the analytical, data validation, and Quality Assurance/Quality Control (QA/QC) issues related to sample analysis;
- Reviewing analytical results and deliverables from subcontractors;
- Incorporating changes in the Workplan, SAP, HASP, and/or other project documents;
- Scheduling personnel and material resources;
- Implementing field aspects of the investigation, including this SAP and other project documents;

- Implementing the QC measures specified in the QAPP in this and other project documents;
- Implementing corrective actions resulting from staff observations, QA/QC surveillance, and /or QA audits;
- Providing oversight of data management;
- Coordinating and overseeing the efforts of the subcontractors providing sampling and analytical support;
- Scheduling and conducting field work;
- Notifying the subcontract analytical laboratory of scheduled sample shipments and coordinating work activities;
- Gathering sampling equipment and field logbooks, and confirming required sample containers and preservatives.
- Maintaining proper chain-of-custody forms and shipping of samples to the analytical laboratory during sampling events;
- Ensuring that sampling is conducted in accordance with procedures detailed in this SAP and that the quantity and location of all samples meet the requirements of the SAP; and
- Identifying problems at the field team level; resolving difficulties in consultation with the QA/QC staff; implementing and documenting corrective action procedures at the field team level; and providing communication between the field team and United Park management.

The roles and responsibilities of other field team members will be to assist the Site Manager with sampling activities, sample handling, and overall documentation.

Oversight activities including sampling to be conducted by EPA's on-site contractor will be coordinated between the EPA Project Coordinator and United Park's Project Manager. EPA's on-site contractor and the Site or Field manager will work together to coordinate sampling efforts.

2.1.1 Quality Assurance/Quality Control Organization

The Quality Assurance Official (QAO) is Gary Colgan, with Aquifer Science, who is responsible for the quality assurance/quality control of the data that are generated during implementation of the SAP. Mr. Colgan will report any QA/QC problems to the Site Manager. As the QAO, he will be responsible for the following:

- Reviewing and approving project specific plans;
- Directing the overall project QA/QC program;
- Maintaining QA/QC oversight of the project;
- Reviewing QA/QC sections in project reports, as applicable;
- Reviewing QA/QC procedures applicable to this SAP;
- Auditing selected activities of this project performed by RMC and subcontractors, as necessary;
- Initiating, reviewing, and following up on response actions to address QA/QC problems, as necessary;
- Consulting with the Site Manager and/or Project Manager, as needed, on appropriate QA/QC measures and corrective actions;
- Arranging performance audits of measurement activities, as necessary; and
- Providing written reports on QA/QC activity to the Project Manager and Site Manager.

2.2 PROBLEM DEFINITION/BACKGROUND (A5)

United Park is the current owner of a large parcel of property (the "Property"), comprising approximately 700 acres, located in Summit County, Utah. Figure 2.0 shows the general geographic location of the Property. The Site included a historic mine tailings impoundment, consisting of a large, geometrically closed basin formed by an earth embankment and a series of perimeter containment dikes and covers approximately 160 acres of the Property. The tailings impoundment resulted from decades of mining and milling silver-laden ore in the area around Park City known as the Park City Mining District. The Site is depicted in Figure 3.0.

The Site has remained unused since mining and milling operations ceased in 1982. Over the past fifteen years, the (EPA), the Utah Department of Environmental Quality (UDEQ) and United Park have been investigating the Site in order to characterize the Site and determine potential adverse impacts to human health and the environment associated with the Site. At the same time, United Park has been implementing a series of remedial measures at the Site intended to mitigate any potential adverse impacts on human health and the environment.

Remedial measures conducted by United Park include the following:

- Placement of clean cover soils over all exposed tailings,
- Reconstruction of the diversion ditch; and,
- Construction of a fence around the property perimeter.

Evaluation of these remedial measures relative to potential site risks is presented in the conceptual site model found in Section 2.2.4 of this document.

A detailed description of the Site, including a description of the Site operational history, existing closure measures and elements, regional geology and hydrogeology and surface water is set forth in Sections 2.0 to 2.5 of the FOCUSED RI/FS Work Plan.

2.2.1 General Goals and Objectives

The purpose of this SAP is to guide additional sampling of environmental media in support of the EPA approved Focused Remedial Investigation Feasibility Study Work Plan. The primary purposes of the remedial investigation for this site are to:

- examine existing data and remedial measures,
- estimate the degree of risk posed to human health and the environment, and
- determine what data are needed to further define the nature and extent of contamination contributing to that risk.

The SAP will identify sample types, number of samples to be collected, and establish sample collection and analytical procedures. The following data will be collected and plans prepared as part of the SAP process:

1. Collect soil, sediment, and water samples to further characterize Site conditions.
2. Provide data to fill data gaps due to seasonal variations in media such as groundwater and surface water.
3. Evaluate existing data to determine the need for further data collection.
4. Collect data of sufficient quality and quantity for EPA to conduct a streamlined risk evaluation.
5. Through this SAP, establish procedures for data collection and analysis.
6. Through this SAP, define Quality Assurance/Quality Control (QAQC) measures.
7. Through this SAP, provide a Site Health & Safety Plan for all workers and visitors.

2.2.1 Historical Data Summary

Previous data have been collected by EPA, United Park and Park City Ventures (PCV). The historic data cover a time period beginning in the early 1970's up to the present. Appendix E contains a listing of known site investigations and reports. Because past investigation activities by PCV, Noranda and United Park were performed without EPA oversight, the results from such investigations will be evaluated as part of, and incorporated as appropriate into, the focused RI/FS. A detailed description of the investigations previously conducted at the Site, which have included investigations of air quality, the extent of the tailings cover, tailings impoundment integrity and stability, and groundwater and surface water quality, are set forth in Sections 3.0 to 3.5 of the FOCUSED RI/FS Work Plan. Based on previous and current environmental studies and existing Site conditions, United Park has developed a draft Conceptual Site Model (CSM). The CSM has been developed with input from EPA, UDERR and the U.S. Fish and Wildlife Service (USFWS). Section 2.2.4 presents the CSM. The CSM will be used to determine what environmental samples are required, how the samples will be used in the risk assessment and derivation of clear SAP objectives. The CSM will be updated and modified as more information is obtained either through sampling or meetings with EPA and other stakeholders.

[Note: Although CERCLA guidance indicates that certain site descriptions that are already included in the FOCUSED RI/FS Work Plan need not be repeated, the descriptions set forth in the following Sections 2.2.1.1 to 2.2.2.4 are included to be more informative.]

2.2.2.1 Surface Water

Section 3.5 of the focused RI/FS Workplan presents a summary of historical surface water data for Silver Creek and the south diversion ditch. Surface water data have been collected on and near the Site since 1975 as part of permit requirements and investigations by EPA and United Park. The data generally show that metals concentrations measured in the south diversion ditch have declined particularly since the mid to late 1980's when the ditch was reconstructed and when the tailings were covered with clean soil (*See,* focused RI/FS Workplan, Table 3.1, Station N5). All exposed tailings have been covered with clean soils as part of voluntary remedial measures. Data collected in 1999 indicate that zinc concentrations measured at the outfall of the ditch meet applicable water quality standards. Zinc concentrations exceed water quality criteria in the central portion of the diversion ditch and both upstream and downstream of the Site in Silver Creek. The downstream Silver Creek zinc concentrations are less than the upstream concentrations indicating that flow from the diversion ditch may be diluting the upstream zinc concentrations.

Table 3.3 in the focused focused RI/FS Workplan presents data collected in May and June of 1999. Additional data collected on the Site for the remainder of 1999 will be presented in the RI report. The 1999 data will be evaluated, following QA/QC criteria set forth in this SAP, to determine if the data, along with information collected in this FOCUSED RI/FS, can be used to guide decisions on what, if any, further remedial actions are required at the Site. If previously collected data do not meet the QA/QC criteria the data will only be used to guide additional sampling following the criteria set forth in this SAP.

Metals measured in 1999 include RCRA metals, copper and zinc. The surface water analyte list was determined based on metals present in tailing samples collected by E&E in 1984. Complete cation/anion analytes were also measured at select stations. (*See*, focused RI/FS Workplan, RMC 2000). Mercury detection limits were not adequate to determine if the water in the diversion ditch meets the chronic aquatic wildlife criteria (12 part per trillion (ppt) – dissolved). Measured mercury concentrations at all site sample locations were non-detectable at less than 0.0005 mg/l. In May of 2000, mercury samples were collected on Silver Creek upstream and downstream of Richardson Flat and on the diversion ditch, as part of the Upper Silver Creek Watershed surface water sampling (*See*, Upper Silver Creek Watershed Analytical Results Report, August 2000, RMC). The detection limit for these mercury analyses was low enough to be below the chronic wildlife criteria. Analytical results indicated that both Silver Creek and the diversion ditch met the appropriate water quality criteria for mercury.

2.2.2.2 Ground Water

Groundwater quality data have been collected in monitoring wells located on and near the Site by EPA, United Park and PCV. The focused RI/FS Workplan and attachments discuss the historic and recent groundwater data. Initial review of the historic groundwater quality data suggests that this data will be of more qualitative than quantitative use. The procedures for QA/QC control detailed in this SAP will be used to determine the usability of the historic data. If the data do not meet QA/QC goals, the data will not be used in decision making directly. Rather, these data will be used to optimize the data gathering process and additional data that meet QA/QC requirements will be collected and used for decision making.

Historical groundwater data generally show that metals concentrations have steadily decreased in Site wells, with the exception of the upgradient well (RT-1) installed by EPA in 1985 and MW-5 located at the toe of the main embankment (*See*, Figure 3.3, focused RI/FS Workplan). EPA sampled RT-1 in 1985 and again in 1992, total and dissolved metals concentrations had increased for aluminum, antimony, arsenic, and barium over the time period.

Comparison of data collected from RT-1 in 1984 and 1992 reveals that water quality appears to have deteriorated at this location over time. Some dissolved metal concentrations have increased from 1984 to 1992. The 1992 data contains some anomalies that suggest either the sample was contaminated or there were some analytical errors. Dissolved metal concentrations are greater than total metal concentrations for antimony, copper, and silver. This suggests that there are sample or analytical errors or interference. The well is completed in two aquifers and there is mixing of water between the two water-bearing zones. During site visits in early 1999, it was apparent that vandals had damaged the wellhead integrity. It is not known if this was apparent in 1992. Thus, surface contamination may have impacted water quality.

A discussion of properly closing this well will take place in Section 3.2 of this SAP.

In 1973, PCV installed three monitoring wells (MW-1, MW-2 and MW-3) at the bottom of the main embankment as part of State of Utah requirements for the tailings impoundment operating permit. In 1976, PCV installed three additional wells (MW-4, MW-5, and MW-6). Figure 3.3 in the focused RI/FS Workplan shows the well locations. It appears that PCV buried monitoring well MW-2 in 1976 during installation of the three new wells. Thus, five groundwater monitoring wells are located near the toe of the embankment. The boring and well completion logs for these five wells can be found in Appendix D of the focused RI/FS Workplan and are summarized in Section 3.4 of the Workplan.

Table 3.2 in the focused RI/FS Workplan presents groundwater data collected by United Park from 1982 to 1987 and 1991 to 1998 from the embankment monitoring wells. Additional groundwater investigation is proposed as a part of the focused RI/FS Workplan. Details outlining sampling and analyses specifics are contained in this SAP.

In 1999, United Park hired Weston Groundwater Engineering, Inc. ("Weston") to conduct a supplemental hydrogeological investigation of the Site. This study represented the most extensive groundwater investigation conducted to date to better understand groundwater systems on the Property. Weston evaluated historical Site and regional data to derive a conceptual hydrogeological site model (*See* focused RI/FS Workplan, Appendix A). In the course of its investigation, Weston installed eleven additional piezometers throughout the Property (*See* focused RI/FS Workplan, Plate 1, Appendix A). Boring logs from the piezometer installation verified the existence of two aquifers associated with the Property. Water level data collected from the piezometers indicates that the two aquifers are confined and are separated from one another by a significant layer of stiff, clay-rich material. Water level data collected after the installation of the piezometers and subsequent water level measurements indicate that the water levels in the two aquifers vary seasonally, with higher water levels occurring in the spring.

The data reported by Weston was not available to earlier Site inspection teams and other agencies that previously evaluated the Site. Studies by Dames & Moore identified the presence of clays in the naturally occurring material at the Site. It was not until Weston's investigation that extent or the significance of the natural clay material underlying the Property was known. The existence of two to five feet of clay-rich topsoil and the presence of the large area of silt and clay that overly the upper aquifer represent a significant barrier to the vertical migration of any water from saturated tailings. Weston has collected monthly groundwater data from February of 1999 to February 2000. These data will be evaluated in a supplemental hydrogeological study and submitted in the RI report. Any additional data that needs to be collected for this study will be done so in accordance with this SAP. Groundwater monitoring proposed as a part of this SAP will be used to verify the Site hydrogeological conceptual model as presented by Weston.

2.2.2.3 Soils

During investigations conducted by EPA and United Park, limited soils data were collected to primarily characterize the tailings soil cover and determine the extent of wind blown tailings. In 1984, EPA collected one soil sample to document background metals and tailings concentrations. Generally, the 1984 data demonstrated that the tailings contain elevated concentrations of metals, and that the soil/tailings contact contains elevated metals, but at lower concentrations than the tailings. In 1992, EPA collected samples of the soil cover to determine the extent and thickness of the cover. Based on the 1992 sampling efforts, the EPA data show that of the 29 sample locations 28 contained soil or vegetative cover and 9 contained no soil cover. Since 1992, United Park has covered all visibly exposed tailings on the impoundment.

2.2.2.4 Sediment

E&E collected four (4) sediment samples at the Site in 1992 in the wetland area between the main tailings embankment and Silver Creek. (*See* Final Report Richardson Flat Tailings, E&E, 1993) The data show that sediments in this area contain elevated concentrations of metals. Water from the south diversion ditch flows from east to west in the wetland area, while Silver Creek flows along the west side of the wetland area. The E&E data show that metals concentrations were elevated in the sediments; however, it appears that there is very little transfer of metals in the sediments to the water. Both historic and recent surface water data show that very little metal is being leached from the sediments. In 1985, E&E reported an increase in lead from 0.036 mg/l to 0.151 mg/l in upstream versus downstream Silver Creek surface water samples.

Additional sediment data will be collected in the diversion ditch as part of the focused RI/FS. The data collected from this sampling will be used to evaluate the long-term effectiveness of the wetland system to remove metals in the water, aid in the determination of the source of metal in water flowing in the diversion ditch and used in an ecological risk assessment to be conducted by the EPA. This data will also be applicable to evaluate long-term effectiveness of metal removal in the wetland area between the main embankment and Silver Creek.

2.2.3 Recent Environmental Conditions

The following conditions have been identified from field work and the chemical analysis of soil, surface, and groundwater samples previously collected at the site by EPA's contractor E&E, United Park and PCV from 1985 to the present time:

- An imported clean fill covers the tailings surface, depth of the cover ranges from less than 6 inches to several feet thick.
- Tailings beneath the soil cover contain the following metals at elevated concentrations: antimony, arsenic, cadmium, copper, lead, mercury, selenium and zinc (EPA, 1992).
- Surface water on and near the Site contains the following metals at low concentrations: arsenic, cadmium, copper, iron, lead, and zinc (focused RI/FS Workplan, 2000). Of the metals detected, only zinc and possibly mercury exceed water quality standards. However, Silver Creek is currently moving through a TMDL process for elevated levels of zinc and cadmium. Zinc levels upstream and downstream of the Site on Silver Creek exceed protection of aquatic wildlife criteria. Laboratory detection limits for mercury were low enough to verify that all samples collected in 1999 were non-detected for mercury at 0.0005 mg/l. The acute aquatic wildlife criteria for mercury is 0.0024 mg/l and the chronic aquatic wildlife criteria for mercury is 0.000012 mg/l or 12 parts per trillion.
- Shallow groundwater at the downstream face of the main tailings embankment contains the following metals at low concentrations: aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury nickel, selenium, silver, thallium, vanadium, and zinc. Of the metals detected, only lead exceeds the Utah Ground Water Quality Standard. (focused RI/FS Workplan, 2000).
- Data collected by E&E in 1992 show that sediments in the wetland below the main embankment contain the following metals at elevated levels: antimony, arsenic cadmium, lead, mercury, selenium and zinc. Surface water data from the wetland area, collected at the same time as the sediment data, show that only lead was elevated when compared to upstream concentrations. It is likely that the wetland sediments, that are rich in organic carbon, are binding the metals and not allowing significant mobilization of metals to occur.

There have been several investigations conducted on the Site by EPA, United Park and PCV over the past fifteen years; Appendix B contains a listing of known site investigation reports.

2.2.4 Conceptual Site Model

The CSM guides the evaluation of risk at a site. It represents our understanding at any moment of the potential for metals to move from a source to a human or ecological receptor. The CSM is a collection of potential specific pathways by which this exposure may occur. A complete exposure pathway consists of five necessary elements:

- A chemical source
- A release mechanism
- An environmental transport medium for the released chemical
- A physical point of contact (the exposure point) for human or ecological receptors
- A route of chemical uptake into the body

All five elements must be present for an exposure pathway to be complete (that is, for chemical exposure to occur). Incomplete pathways do not result in exposure to humans or biota, and therefore do not result in risk. Complete pathways may result in such a small exposure that risk is not significant. Where possible, the risk assessment process will evaluate both the completeness and the significance of the pathways. The conceptual site model helps to identify the data needed in the risk assessment process to complete this analysis.

In the following section, the potential sources, release mechanisms, exposure media, exposure points, and human and ecological receptors will be briefly described, and then potential pathways from source to receptor will be discussed one by one. Existing data will be reviewed to identify data gaps. The sampling plan described in this document is intended to begin to fill the data gaps and reduce uncertainty about the potential for risk from each exposure pathway.

2.2.4.1 Sources

The source of metals at the site is the historical placement of tailings from mining operations elsewhere. To better understand the potential release of metals, the original source has been conceptually divided into two parts: (1) the tailings that are contained within the tailings impoundment where they are covered by a clay soil cover or cap and contained within a containment dike system, and (2) the tailings that are covered in small, naturally low areas outside and to the south of the impoundment. The conceptual site model for the impounded tailings is illustrated in Figure 8a and the model for tailings placed outside of the impoundment is in Figure 8b.

2.2.4.2 Release Mechanisms

Four primary release mechanisms have been identified: (1) direct contact with the tailings; (2) direct contact with soils that are the result of the mixing of the tailings with cover soils inside and outside of the impoundment, potentially due to root transport through cover soils; (3) infiltration by rainwater and snowmelt and subsequent leaching of metals into ground or surface water; and (4) historic wind erosion of the tailings before the cap was placed on them.

A secondary release mechanism may be the removal of metals in diversion ditch surface water through biological processes, resulting in metal deposition in the sediments. This is indicated by the apparent reduction in zinc concentrations as the water moves down the ditch to Silver Creek.

2.2.4.3 Exposure Media

The primary media to which humans or ecological receptors may be exposed as a direct result of release from the source include the tailings themselves; the cover soils mixed with tailings (if that has occurred); surface water; and any windblown tailings that are off site.

Metals have also been found in sediments in the wetland below the main embankment. (The origin of these metals is uncertain; they could be from Silver Creek tailings or impoundment tailings via the diversion ditch). There may be metals in the sediments in the diversion ditch possibly due to biochemical removal processes present in the diversion ditch wetlands. Data show that the metals concentrations in the diversion ditch surface waters decrease, , as the water moves down the ditch toward Silver Creek. Sediments in the ditch may be a secondary exposure medium. If the enhanced metals levels have occurred due to a biological reaction, it may be that these metals have a relatively low bioavailability for both ecological and human receptors.

Groundwater exposure does not occur for humans on site, since there are no drinking water wells. Potential for offsite exposure has not been evaluated yet. It is possible that metals are released from tailings (in or out of the impoundment) into groundwater and then captured by downgradient wells. Ground water exposure may be a transport medium but not an exposure medium for ecological receptors in two very localized situations: (1) if ground water is affected by off-impoundment tailings and is intercepted by the south diversion ditch, or (2) if shallow ground water creating the seeps at the base of the embankment is affected.

Surface water in four main areas around the site (Silver Creek, the drainage ditch system, ponded water in the northwestern area of the impoundment, and the seeps discussed above) may be affected by transport of metals from the tailings. Parts of this sampling plan are intended to investigate whether (or how) this is occurring and, if so, which potential source (impounded tailings, or tailings outside of the impoundment) is responsible.

Prior to the tailings being covered, it appeared that wind blew quantities of tailings off the impoundment, primarily to the north and northwest. Off-site soils have not been investigated to determine the extent and degree of effects from these windblown tailings. Such data are needed to complete the risk assessment and planned sampling is described in this SAP.

2.2.4.4 Exposure Points

Exposure points are those specific physical locations where receptors may be exposed to site-related materials. The locations are selected for evaluation of risk based on existence of elevated chemical concentrations, present or future existence of receptors of concern, sensitivity of receptors, or similar considerations. Measured or modeled concentrations of site chemicals in media of concern at the exposure points are usually needed to complete the risk assessment, unless cost outweighs the benefits of reducing uncertainty about risk at those points. At present, identified potential exposure points include:

- tailings or soils mixed with tailings outside of the impoundment;
- areas on the impoundment where there may be exposure to tailings, or tailings mixed with cover soils, on the impoundment;
- water and sediments in the diversion ditch;
- water and sediments in Silver Creek;
- off-site areas that received historic wind-blown tailings; and

- areas that may have received water runoff, seeped water, or sediments containing site-related metals, including the wetland area to the northwest of the site at the base of the embankment.

2.2.4.5 Potential Receptors and Routes of Exposure

Potential human receptors are discussed here as "site visitors" and "off-site receptors" until they are defined further. Site visitors now include:

- people working on or studying the site, and
- recreational users of the nearby bike path who may wander or trespass on to the site.

In the future human receptors may include on-site recreational users. Off-site receptors are those residents, workers, or recreational users such as hikers or hunters who may encounter water, sediments, or windblown tailings that have migrated off the site. At present, no one is known to live within about 3 km or more from the site; the closest residences are about 3 km upstream near Prospector Square in Park City, and at least 5 km downstream, and the closest off-site workers are at the facility about 0.5 km to the north across Highway 248.

Humans may be exposed to metals via incidental ingestion of soils and sediments, via dermal absorption of metals that may adhere to skin, and via inhalation of dust derived from the soils and suspended in the air. The most significant of these routes relative to the others is incidental ingestion. Dermal absorption of metals is usually assumed by EPA to be very low, and it can readily be shown that inhalation of suspended dusts derived from soils presents an insignificant risk compared to directly ingesting those same soils. For example, in the risk assessment for the Murray Smelter, EPA indicated that the dermal and inhalation exposure routes "may be complete; however, risk is low" and the exposure routes would receive "qualitative evaluation only." (See Figure 3-1, Weston, Inc., Baseline Risk Assessment, Murray Smelter, 1996)

To conduct the ecological risk assessment, the ecological receptors of concern must be specifically selected. Since that has not yet been done, we have used two general habitat categories (wetland and upland) and four general biota categories (avian, invertebrates), other non-avian vertebrates (including fish, frogs, mammals), and plants (vascular and non-vascular) to start thinking about ecological risk and to identify general data gaps. At this point, the potential for uptake through a food chain or web is noted with the route "food chain exposure," which is intended to indicate consumption of plants, benthic or soil invertebrates, or other food items by herbivores or carnivores. Obviously this exposure route is not possible to the plants themselves. For many invertebrates the food chain pathway is also unlikely or insignificant, although some herbivorous or carnivorous invertebrates such as beetles may take up metals from food items. The ecological risk assessor will develop significant details of food web issues later, if necessary.

Ecological receptors live in intimate contact with environmental media and may receive exposures via a number of exposure routes, depending on their life habits. To accommodate the variety of potential routes, at this point we have simply divided the exposure routes into "direct exposure" (which could include ingestion of soil or sediment while feeding or grooming, dermal absorption while burrowing or dirt bathing, and inhalation or water breathing, just for example) and "food chain exposure" which would cover anything else. Again, details will be developed later by the ecological risk assessor.

2.2.4.6 Discussion of Potential Exposure Pathways

In this section, each identified potential exposure pathway from source to receptor will be discussed relative to existing data, probable completeness or significance, and data needs to reduce uncertainty. If a pathway is designated as "potentially significant" in this CSM description, that does not mean that there is a risk; it merely indicates that further evaluation by the risk assessors is appropriate based either on existing data or on current uncertainties about potential risk. Data needs are briefly summarized in Table 1; specific sampling plans are detailed later in this SAP.

2.2.4.7 Background Metals

All potential exposure pathways related to this site must be considered relative to naturally occurring background levels of metals in soils, sediments, and water. Many site-related metals occur naturally in soils and food items and some, including zinc and copper, are essential for life. The area surrounding the site is highly mineralized, so typical natural background levels of these metals may be higher than those found in other areas. At present, some background information is available for nearby areas, but none is available for soils typical of the site itself. This information would provide important context for the risk assessment. This SAP describes the planned collection of background soil samples in Section 3.1.3.

2.2.4.8 Direct Contact with Tailings

Direct contact with tailings in the impoundment can only occur if human visitors, animals or plants penetrate the existing soil cover. This cover varies in thickness from perhaps 5 feet down to less than a foot in limited areas. For humans, such contact is considered unlikely, and even if it occurred, it would be insignificant. Humans are unlikely to eat any food products from plants growing anywhere on the site, so any sort of food chain exposure pathway for humans due to plants contacting tailings is also considered insignificant. This is indicated in Figure 8a. The soil used to cover the tailings was obtained locally from sources that were free of mine waste, such as excavation waste from residential construction. For ecological receptors, direct contact could only occur in areas where the soil cover is thin and where animals burrow or plants grow roots that are deep enough to penetrate the cover. This sampling plan includes an investigation of whether the soil cap is thin or absent in some areas, and whether soil/tailings mixing has occurred.

Off site, contact with tailings could occur for both human and ecological receptors. This pathway is therefore probably complete and potentially significant for ecological receptors. Additional sampling of the tailings is planned. The areal extent of these tailings appears to be limited but more data on their nature and extent is needed and will be collected as part of this sampling program.

2.2.4.9 Contact with Tailings Mixed with Soil

Because the cap is thin in some areas, it is possible that placement of the soil cover, animal burrowing, root transport, or other processes have mixed the cover soils with the tailings. No data currently exist to evaluate this possibility. If mixing has occurred, exposure is possible for both human site visitors and ecological receptors and the pathway should be considered potentially complete.

2.2.4.10 Contact with Ground Water

Direct exposure to the shallow ground water is not likely (except by very deep-rooted plants, not currently known to live at the site, or plants in the diversion ditch if indeed the ditch sometimes intercepts groundwater), but if groundwater is being pumped to drinking water wells, then people living or working off-site may be exposed if they ingest the water. Contact with ground water on site is an incomplete pathway for humans; on-site well water is not used for human consumption in any way.

Human contact with ground water potentially affected off-site is not known to be a complete pathway but a well survey is needed to be more confident of this. As part of the Remedial Investigation (RI) for this site additional data will be collected on nearby wells. The data will include drilling depths, geological sequences encountered, and water quality data. The hydrogeological report by Weston Engineering presented in Appendix A of the workplan (RMC, 2000) will be updated with the additional data. The scope of the hydrogeological conceptual model will be enlarged to include these off-site wells.

Based on existing information, the possibility that metals might migrate more than a short distance in ground water before surfacing appears unlikely. The groundwater report currently in preparation by Montgomery Watson is expected to show that the very low permeability clay layer underneath of the tailings impoundment prevents significant downward migration of metals into the aquifer (see Figure 4.0 in the Workplan), preventing entry of metals into the aquifer and preventing groundwater transport off-site. Short-distance lateral movement in the shallow alluvial aquifer is still possible through the sides of the impoundment, potentially allowing metals to be released into the diversion ditch to the east, south, and west of the impoundment, and at the toe of the embankment nearest to Silver Creek on the west. However, available data show that very low-flow, seasonal seeps appear not to reach Silver Creek, over 500 feet away.

2.2.4.11 Contact with Surface Water

Surface water potentially affected by the site can be found in at least some years and seasons ponded on top of the impoundment cover itself; in the diversion ditch; in the wetland area to the northwest of the impoundment; and possibly in Silver Creek. Silver Creek itself may have naturally enhanced concentrations of metals and does have enhanced levels of metals due to historic mining activity as well as potential impacts from other recreational and residential uses upstream. Data from standing surface water on the impoundment collected in 1999 (*see*, focused RI/FS Workplan, RF-9) detected only barium and zinc, both of which were below aquatic wildlife criteria, so exposure is unlikely by this pathway. Metals concentrations measured in the south diversion ditch have declined particularly since the mid to late 1980's when the ditch was reconstructed and when the tailings were covered with clean soil. As stated earlier, data collected in

1999 indicate that zinc concentrations measured at the outfall of the ditch meet applicable water quality standards. Zinc concentrations exceed water quality criteria in the central portion of the diversion ditch and both upstream and downstream of the site in Silver Creek. The downstream Silver Creek zinc concentrations are less than the upstream concentrations indicating that flow from the diversion ditch may be diluting the upstream zinc concentrations. Existing data appear adequate to evaluate human health risk. While the human pathway appears complete, existing data indicate it is unlikely to be a significant pathway.

The surface water pathway therefore appears complete and potentially significant for ecological receptors in the diversion ditch, but not on top of the impoundment itself. Additional data have been requested to support the ecological risk assessment and to better understand the migration of metals from the site sources, and this sampling plan describes activities to help further evaluate upstream and downstream water quality in the Silver Creek alluvial aquifer to assess impacts from the tailings impoundment. Data provided by Weston show that the creek typically loses water into the alluvial aquifer in the stream reach near the impoundment. Depending on the season, the water may flow both ways depending on ground water levels and stream water elevation. This SAP describes plans to collect ground water and surface water elevation data to quantify this.

Human site visitors may be exposed to this water occasionally if they try to explore or play in the area or fish in the creek. There are no water recreation areas for swimming or boating on or near the site. At certain times of year the water flow in the ditch is quite high and contact is unlikely. Indirect exposure to metals in surface water (as well as sediments, depending on the circumstances) is possible through ingestion of fish exposed at the site; although this pathway might be complete at some point, it is unlikely to be a significant route of exposure due to low uptake of the metals by fish and low consumption rates due to the small size of the stream. Human exposure to site-related metals in surface water is possible but is expected to be fairly low overall.

Exposure to surface water by ecological receptors is potentially significant and further evaluation will probably be required. Surface water data for each of the exposure points do exist. If additional data are collected for the purpose of ecological evaluation, they should be collected as part of a specific plan that will need to be developed with the ecological risk assessor. The planned collection of ground water elevation data will be critical to determining whether the actual pathway from Richardson Flat tailings to ecological receptors is complete and a significant contributor to any exposure in Silver Creek.

Tailings outside the impoundment, may be contributing to elevated levels of metals in surface water at some exposure points such as the diversion ditch. A focus of the current data collection program is to clarify which source is the significant contributor. This information will help to clarify effective remediation strategies.

2.2.4.12 Contact with Sediments

Similar to the situation with surface water, human contact with sediments is a possible, even probable complete exposure pathway, but it is unlikely to be significant. To be significant, there would need to be high concentrations of bioavailable metals in the sediments and children would have to routinely and frequently play in the stream and wetland areas, dirty their hands, and ingest the sediments through hand-to-mouth behaviors. Existing and planned sediment data are adequate for evaluating this pathway to humans. The EPA report in the work plan presents data from the wetland below the main embankment. The source of these sediments (Silver Creek or Richardson Flat impoundment tailings) is not certain.

Again similar to the situation with surface water, ecological receptor contact with site-related metals in sediments may be a complete exposure pathway, but risk cannot be evaluated at this time. Sediment sampling is currently planned for 6 locations in the diversion ditch. Understanding the ecological risk from these metals may require additional data collection but the additional data needs cannot be determined at this point As with all potential data collection, data needs will be balanced with considerations of their value versus the cost of remedial alternatives that could be conducted despite uncertainty about risk. Data needs may include a consideration of bioavailability since if the sediment metals were derived by precipitation from the water, they may have very low solubility and bioavailability.

2.2.4.13 Contact with Wind Deposited Tailings Off Site

Humans off-site and upland ecological receptors may be exposed to off-site wind-deposited tailings, if the tailings have caused elevated levels of metals. No data currently exist to evaluate this. There currently are no residential areas in the suspected area of potential impact. This sampling plan describes a tiered, cost effective approach to sampling soils in the potentially affected areas; if elevated metals are detected above the levels designated in the sampling plan, then additional samples will be collected in areas further away until the affected area can be delineated.

2.2.4.14 Summary of Potentially Complete Exposure Pathways

Human receptors
- incidental ingestion of tailings outside the impoundment
- incidental ingestion of affected surface water
- incidental ingestion of affected sediment
- incidental ingestion of wind-deposited tailings off-site

Ecological receptors
- contact with tailings in the impoundment;
- contact with tailings outside the impoundment;
- contact with affected surface water;
- contact with affected sediment;
- contact with wind-deposited tailings off-site (off-site or highly mobile species only)
- food chain exposure to metals from food items exposed to the above exposure media

2.3 PROJECT/TASK DESCRIPTION (A6)

As summarized in the focused RI/FS Work Plan, extensive investigation work has already been completed at the Site. Moreover, over the years, United Park and others have taken actions to support final closure of the Site, including the installation of a soil cover over the tailings, drainage ditches, and a security fence. In order to evaluate the need for further remedial measures needed to support final Site closure and to assure that the existing remedies in place are adequate and have longevity, United Park will conduct the additional remedial investigation work described in Sections 5.0 to 5.7 of the focused RI/FS Work Plan.

The following objectives of the remedial investigation are:

Soils and Tailings

1. Determine metal concentrations in imported cover soils, provide data of sufficient quality and quantity for analyzing risks to human health and for comparison with ecological screening levels and background. Verify extent (vertical and lateral) of imported cover soils on tailings.
2. Screen for impacts to off-impoundment soils and delineate the site boundary. Delineate all areas of potential impacts through the use of human and ecological screening levels.
3. Collect geochemical and physical data on tailings to evaluate long-term fate and chemical stability.
4. Delineate extent of tailings outside of impoundment and determine impacts to surface and ground water.
5. Determine background soil metal concentrations.

Surface Water and Sediments

1. Collect sediment data in the south diversion ditch to aid in identification of the location of metal loading in the ditch. Use the data to determine long-term chemical fate and stability of metals in the sediments and in ecological risk assessment.
2. Collect data in Silver Creek and in drainages associated with the site to aid in determination of the background water quality relative to the site and the site's impact on water quality in Silver Creek, including seasonal variation. Provide additional surface water data for comparison with human health and ecological screening levels.

Groundwater

1. Determine metal concentrations in the Silver Creek shallow alluvial ground water both up and down stream of the impoundment.
2. Collect surface and ground water elevation data to quantify the interaction between shallow ground water and Silver Creek, including seasonal variations.

2.4 DATA QUALITY OBJECTIVES for MEASUREMENT DATA (A7)

Data Quality Objectives (DQOs) are quantitative and qualitative statements specifying the quality of the data required to support decisions during site investigations and removal actions. DQOs and associated data quality levels are based on the end uses of the data and are determined by the methods of analysis and the level of QC and documentation that are used to produce the data. Tables 1 and 4 summarize the DQOs, data uses, analytical methods, and QC level required for the sampling. All data collected during the focused RI/FS, except for decontamination water samples collected for pH testing in the field, will be considered "definitive" consistent with EPA Superfund Data Categories (EPA, 1993) and (Table 1). pH testing does not fall within the Superfund Data Categories (EPA, 1993), and for the purpose of this plan will be considered Screening. Screening and Definitive data are defined as follows:

- Screening data will be defined as data collected by Standard Operating Procedures (SOP's), such as water-level measurements and pH measurements, using field instruments calibrated according to manufacturer's specifications and SOP's. The data deliverables produced and QC documentation are not as rigorous as requirements for Definitive data. The data may be used for site monitoring and characterization.
- Definitive data will be defined as data produced using EPA-approved methods. The data deliverables may or may not be equivalent to Contract Laboratory Procedures (CLP) Routine Analytical Services (RAS). However, the data deliverables produced and the QC documentation may not be as rigorous as the CLP requirements for documentation. The data may be used for risk assessment, site characterization, and site monitoring.

DQOs are expressed in terms of precision, accuracy, representativeness, comparability, and completeness (PARCC). Table 3 summarizes the quality assurance goals in terms of the five PARCC criteria.

2.5 SPECIAL TRAINING REQUIREMENTS/CERTIFICATION (A8)

Besides OSHA training and certification for hazardous waste site workers (29 CFR 1910.120), no special training or certification requirements have been identified for this project.

2.6 DOCUMENTATION AND RECORDS (A9)

The following documentation and records will be maintained for the project:

Field Operation Records:
- Sample collection records (i.e., bound field notebooks)
- Chain-of-custody records
- QC sample records (information recorded in field notebook)
- Corrective action reports

Laboratory Records:
- Sample data
- Sample management records
- Test methods
- QA/QC reports.

Records will be maintained at UPCM offices for ten years after data collection.

3.0 MEASUREMENT / DATA ACQUISITION (B)

This SAP is intended to be a guide for United Park's Project Manager, field personnel and EPA's oversight contractor in implementing the remedial investigation at the Site. This section addresses all aspects of the collection and measurement systems design and implementation ensuring that appropriate methods for sampling, analysis, data handling, and QC are employed and documented.

A 2' topographic map is available. This digital map was prepared in the summer of 1998. All surveying to be completed for the focused RI/FS will be tied to the coordinate system for this map. Points will be established on the ground for referencing any hand-held GPS equipment used in the study.

3.1 SAMPLING PROCESS DESIGN (B1)

All sampling measurements described below are required to achieve the project objectives. The focus of sample collection activities proposed in this SAP is evaluation of the following environmental media:

- Surface water sampling of Silver Creek, the Diversion Ditch, and its tributaries, and the ponded water within the impoundment.
- Groundwater sampling for water quality and elevation in the existing wells and wells associated with the evaluation of the shallow aquifer in Silver Creek.
- Soils sampling off site to evaluate the migration of contaminants and determine background metal concentrations in soil.
- Sediment sampling in the Diversion Ditch to support the risk analysis, the study of the long-term viability of the wetlands in the ditch and to determine the contribution, if any, to the metal loading in surface waters flowing in the ditch.
- Samples of the soil cover over the tailings to determine depth of cover and any surface contamination.
- Tailings sampling to support the determination of the long-term chemical stability of the tailings.

A summary of sample media, locations, analytes and sampling objectives is provided in Table 5.

3.1.1 Surface Water

Surface water samples will be collected at a minimum of five (5) locations on or near the Site as depicted on Figure 4. The sample locations were selected based on data collected in 1999 and 2000. Data from these sample locations will be used to characterize seasonal water quality and quantity in the main Ditch, as well as the unnamed drainages flowing into the south diversion ditch and Silver Creek. Data from the unnamed drainages will provide limited background water chemistry data, the unnamed drainages only flow in response to snowmelt or significant storm events. Furthermore, the data will be used to determine the effect(s) of the Site on Silver Creek water chemistry and provide information in support of a study to determine the source of elevated zinc concentrations found in the middle reach of the diversion ditch. Samples will be collected monthly at each location through at least one complete seasonal time period. United Park intends to use data collected at these stations in 1999 to complete the annual cycle of data collection. The 1999 and 2000 data will be evaluated for QA/QC requirements found in this document. If the 1999 and 2000 data do not pass QA/QC requirements, then additional data will be collected to fill in the data gaps.

The samples will be collected according to the RMC Standard Operating Procedures (SOP) for Surface Water Sampling SOP 1 presented in Appendix C. Field and laboratory analytical parameters are shown on Table 2 of this SAP. Sample collection will be conducted according to procedures in Section 3.2. Analytical and laboratory procedures that will be followed are detailed in Section 3.4 of this SAP. Actual sample locations and surface water elevation data will be logged with a Global Positioning Survey (GPS) unit or located with conventional survey methods.

3.1.2 Ground Water

United Park will install two monitoring wells in the Silver Creek shallow alluvial aquifer. The wells will be installed upgradient and downgradient of the Site as shown on Figure 4. Monitoring Well RT-11 shall be installed in the vicinity of Silver Creek to the west of the impoundment area. Monitoring Well RT-12 shall be placed in the vicinity of Sliver Creek downgradient from the impoundment area. Existing wells may be used to the extent possible. Groundwater and surface water levels will be measured at each location to determine flow characteristics between the surface and groundwater system. Samples will be collected monthly starting after installation and continuing for twelve (12) months. Water level and quality data from the wells will be used to verify the Site conceptual hydrogeologic model and determine what, if any, impacts to the shallow alluvial aquifer adjacent to Silver Creek are occurring from the Site. The hydrogeological model presented by Weston (Appendix A, focused RI/FS Workplan, 2000) shows that the shallow aquifers present near the Site are separated from the tailings aquifer by a 10-15 foot clay soil layer. Groundwater quality data to date only suggest that the monitoring wells on the downstream face of the main embankment contain elevated levels of metals and only in wells completed within the top six feet of the ground surface. Beyond seepage across the tailings embankment, there is no apparent hydraulic connection between groundwater stored in the tailings and underlying and adjacent shallow alluvial aquifer(s). (*See* Weston, 1999)

The monitoring wells will be installed according to the RMC SOP 3a (Ground Water Monitoring Well Installation) presented in Appendix C. Field and laboratory analytical parameters are shown on Table 2. Groundwater samples collected from monitoring wells will be analyzed for total and dissolved metals as specified in Table 2. The proposed monitoring well locations are shown on Figure 4. Sample collection will be conducted according to procedures in Section 3.2; analytical and laboratory procedures that will be followed are detailed in Section 3.4 of this SAP. Section 3.2, Sampling Methods, describes the procedures that will direct sample collection. The well locations will be logged with a Global Positioning Survey (GPS) unit or located with conventional survey methods.

3.1.3 Onsite Soils Cover Sampling

At approximately forty-two (42) locations, soil samples will be collected on the tailings impoundment to determine: 1) the extent and thickness of the soil cover and 2) chemical characteristics of the surface soils. EPA will use this data, in the risk assessment process to evaluate the potential for impacts to human health and the environment from the Site soils. Sample locations are shown on Figure 5. Samples will be collected at the surface (0-2") at each location and initially analyzed for lead and arsenic to characterize the cover materials for potential human and ecological risks from exposure to the cover soils. All samples will be analyzed for lead and arsenic and 20% of all surface samples collected will be analyzed for RCRA metals including copper and zinc. The thickness of the soil cover will be determined by excavating either by hand, core sampler or backhoe down to the soil/tailings interface. The interface will be visually verified at each location; the tailings are a characteristic grey color, sandy texture, while the soil cover is red-brown color and has a clayey texture. Approximately ten (10) samples will be collected just above the cover/tailings interface and submitted for laboratory analyses to verify the visual method. Table 2 lists the target metals for the depth of cover samples, target metals were selected based on results of the E&E air monitoring activities conducted in 1984. The surface sample (0-2") data will be used by EPA determine if the cover material presents a threat to human health or the environment. Based on the outcome of this sample event additional analyses may need to be performed to determine risk to human health or the environment.

On-site soil sample locations are shown on Figure 5. Sample collection will be conducted according to procedures in Section 3.2. Analytical and laboratory procedures are detailed in Section 3.4 of this SAP. Actual sample locations will be logged with a Global Positioning Survey (GPS) unit or located with conventional survey methods.

3.1.3.1 Off-Site Soils Cover Sampling

At approximately twenty-four (24) locations, soil samples will be collected along three transects, oriented perpendicular to the prevailing wind direction, to assess the extent and potential human health and/or environmental impacts from wind blown tailings. The prevailing wind direction is from the southeast as determined by EPA's contractor in the 1986 Air Sampling at Richardson Flat. A wind rose from the EPA Air Sampling Report is presented as Figure 7. Sample locations are shown on Figure 6. Samples will be collected at 0-2" and 1-6" intervals along the transects indicated on Figure 6. Data from this sampling effort will be used in the risk assessment process to evaluate if there is a threat to human health or the environment from exposure to off-site soils. If impacts to off-site soils are found additional sampling may need to be performed to further define the extent and nature of the impacts and to evaluate risk to human health or the environment.

Off-site soil sample locations are shown on Figure 6. Sample collection will be conducted according to procedures in Section 3.2. Analytical and laboratory procedures are detailed in Section 3.4 of this SAP. Actual sample locations will be logged with a Global Positioning Survey (GPS) unit or located with conventional survey methods.

3.1.4 Sediment

At approximately six (6) locations, sediment samples will be collected in the south diversion ditch. These samples will aid in the determination of the source of elevated zinc concentrations in water samples collected in 1999 and 2000. Sufficient sample will be taken for additional testing if desired. Long term fate and transport modeling of metals in the sediments (*See,* focused RI/FS Workplan, Table 3.4) will be performed to evaluate risk to the environment from metals bound in the organic substrates within the diversion ditch sediments. The samples will be collected at locations shown on Figure 5. At each location, samples will be collected at the surface and down to a depth of six (6) inches. The sediment samples will be analyzed for metals in soils listed in Table 2. These samples will be archived in a secure facility until it can be determined whether additional analysis is required. The samples will be stored in tamper proof containers and kept at 4 degrees Celsius. Additional samples may need to be collected in the future to refine the risk assessment.

All sediment sample locations are shown on Figure 5. Sample collection will be conducted according to procedures in Section 3.2. Analytical and laboratory procedures are detailed in Section 3.4 of this SAP. Actual sample locations will be logged with a Global Positioning Survey (GPS) unit or located with conventional survey methods.

3.1.5 Tailings

At three (3) locations, samples of tailings will be collected within the impoundment. The purpose of this sample collection effort will be to collect data to evaluate the long-term fate of the metal in tailings and the chemical stability of the tailings. Presently, environmental data suggest that very little if any leaching of metals is occurring. The samples will be collected at locations shown on Figure 5. At each location, five (5) discrete samples will be collected at one (1) foot vertical increments, starting from the bottom of the cover over the tailings down to a depth of five (5) feet below the ground surface. Sample and analytical procedures will be consistent with sections 3.2 and 3.4 of this SAP. The discrete samples will be analyzed for metals in soils presented in Table 2. In addition, a composite sample comprising a split of each increment will be prepared and analyzed for acid/base potential in order to allow prediction of long-term geochemical characteristics of the tailings materials. The samples will either be collected by excavating a test pit with a backhoe or with direct push methods. The Project Manager, following discussions with the EPA Project Coordinator, will make this determination in the field.

To maximize visual observations of tailings, soils and the tailings/soils interface as well as maximize sample quantities, a backhoe will be used to dig test pits in selected locations. The test pit will enable site personnel to view the soils/tailings interface in a three-dimensional view. This will provide an understanding of the physical characteristics of the interface as well as provide information about the spatial configuration of the interface. Test pits will be excavated with minimal disturbance and shall not be excavated below the current water table. Excavated soils will be sorted and stockpiled adjacent to the test pit. Upon completion of sampling activities the test pit will be backfilled. To prevent soil mixing, each soil horizon will be backfilled with soils removed from that horizon. Soils will be compacted with the bucket of the backhoe during backfilling.

3.1.5.1 Delineation of Tailings South of the Diversion Ditch

The tailings outside of the impoundment have been covered with at least one to up to five feet of clean soil (*See* Section 4.2, focused RI/FS Workplan). The actual limit and extent of the tailings south of the diversion ditch will be identified using a combination of aerial photography review and investigative field methods. The approximate limits of these tailings are marked with a dashed green line as the "tailings outside of the impoundment" on Figure 5.0. The results of this investigation will aid in providing a definitive model of the extent of the tailings located south of the diversion ditch and to define study boundaries. Subsurface samples will be collected to determine: 1) the extent of tailings south of the south diversion ditch, 2) the thickness of soil cover on these tailings, and 3) whether these tailings are contributing to elevated zinc levels in the diversion ditch.

As described in Section 5.2 of the focused RI/FS Workplan (RMC, 2000), the purpose of this sampling effort is to evaluate the potential for tailings in this location to impact groundwater and surface water in the south diversion ditch. Data collected will be used in conjunction with the sediment samples collected from the Diversion Ditch. Subsurface samples will be collected using a combination of shallow hand tool excavation, backhoe test pits, boreholes or direct push methods. These four methods will involve the visual inspection of subsurface soils. To confirm the results of visual inspection, analytical samples will be collected at 10% of the locations visually inspected. The analytical soil samples will be collected above and below any color or texture changes. The soil samples will be analyzed for metals in soils presented in Table 2.

Two piezometers, designated RT-13 and RT-14, will be installed in the tailings outside of the impoundment. Figure 4.0 shows the locations, the piezometers will be completed in the tailings. To prevent the migration of water between the tailings and underlying native soils, borehole intervals below the tailings/native soil interface will be plugged with bentonite pellets. The borehole will be plugged to approximately one foot (1') above the tailings/native soils interface. The piezometers will be installed and monitored even if groundwater is not observed during drilling/sampling activities. The piezometers will be installed in specific areas to further define the hydraulic gradient that exists in any water that may be within the tailings outside the diversion ditch. The presence of water in these piezometers and the relationship that its' gradient has to the water in the diversion ditch will help identify areas of possible metal loading in the diversion ditch. Water quality data from these piezometers will not be collected. Water quality data is not as critical as the relative elevation data is in determining the potential metal loading to the diversion ditch that any tailings south of the diversion ditch may be causing. Based on the outcome of the groundwater evaluation, United Park may collect additional subsurface data to determine the volume, extent and environmental impacts from tailings in this area.

A review of historical aerial photographs will be conducted to assess the outermost limits of the tailings south of the diversion ditch. The approximate location of tailings will be determined from reviewing a series of historical aerial photographs. Where possible, the location of the tailings will be determined by examining the photographs for discontinuities that may be indicative of the boundaries of the tailings and native ground. These discontinuities may include changes in plant cover, drainage patterns and general geomorphology. The locations of the tailings/native ground boundary will be compared to the locations of known points such as fencing and roads. The boundary will then be staked on the ground using the known points as reference locations. The staked boundary locations will act as a starting point for the field delineation of the tailings/native ground boundary.

The extent of the tailings will be staked during the field investigation. At the completion of field activities, the boundary will be surveyed using conventional survey techniques. The survey data will be used to update the current boundary on Figure 5.

Sample location, collection and laboratory procedures that will be followed are detailed in Section 3.2 of this SAP.

Analytical soil sample collection will be conducted according to procedures in Section 3.2, analytical and laboratory procedures that will be followed are detailed in Section 3.4 of this SAP. Actual sample locations will be logged with a Global Positioning Survey (GPS) unit or located with conventional survey methods.

3.1.6 Background Soils Samples

At approximately twenty-five (25) locations, background soil samples will be collected in areas that have not been affected by tailings deposition. The samples will be used: 1) to determine the concentrations of metals in areas not affected by tailings deposition and 2) to obtain baseline, background values for soils metals concentrations in the vicinity of the tailings impoundment. Sample locations are shown on Figure 2.

Discrete samples will be collected at the surface (0-2") at each location and initially analyzed for lead and arsenic to characterize the background concentrations of metals in the area surrounding the tailings impoundment. All samples will be analyzed for lead and arsenic and 20% of all surface samples collected will be analyzed for RCRA metals including copper and zinc.

Background soil sample locations are shown on Figure 2. Sample collection will be conducted according to procedures in Section 3.2 and RMC SOP 2a. Analytical and laboratory procedures are detailed in Section 3.4 of this SAP. Actual sample locations will be logged with a Global Positioning Survey (GPS) unit or located with conventional survey methods.

3.2 SAMPLING METHOD REQUIREMENTS (B2)

Sampling method requirements for each sample type are described below. Table 4 summarizes the sample containers, preservation requirements, and analytical holding times for each analytical method.

3.2.1 Surface Water Samples

Surface water samples will be collected following RMC's SOP 1, included in this SAP as Appendix C. These procedures will be followed for any water samples collected in this focused RI/FS. Water samples will be collected at five (5) locations on or near the Site, as shown on Figure 4. Analytical parameters vary depending on the data objective at each location. For the most part, complete cation/anion and metals (dissolved and total) samples will be collected. Table 1 presents the data quality objectives. Table 2 presents the parameters, analytical methods, laboratory methods, container types, preservation requirements and holding times for each type of analyte. Table 5 presents the analytes to be collected at each location. At each location, field data, including pH, temperature and specific conductivity will be collected after the laboratory sample has been collected, preserved and stored.

3.2.2 Ground Water Samples

Groundwater quality samples will be collected at two (2) new monitoring wells installed in the Silver Creek alluvial aquifer and two monitoring wells installed in the tailings south of the diversion ditch. Additional data collected will include field parameters (as with surface water samples) as well as water elevation in the well. Elevations will be referenced to the ground surface adjacent to the well. Figure 4 shows the approximate locations of the monitoring wells. In addition, sampling of existing wells will occur in accordance with this RMC SOP 3c and this SAP. The wells will be installed according to SOP 3a. Prior to sampling, the wells will be developed according to SOP 3b. The wells will be sampled according to RMC SOP 3c. Table 1 presents the data quality objectives. Table 2 presents the parameters, analytical methods, laboratory methods, container types, preservation requirements and holding times for each type of analyte. Table 5 presents the analytes to be collected at each location. At each location, field data, including pH, temperature and specific conductivity will be collected after the laboratory sample has been collected, preserved and stored.

After well installation, a licensed land surveyor registered in the State of Utah will survey the locations of the new wells. Surveying will include horizontal coordinates (Northing and Easting) for the well location, and vertical elevation datum for the top of casing. Vertical accuracy will be within 0.01 feet and horizontal accuracy will be within one (1) foot.

One existing groundwater well, No. RF-1, will be sampled and then closed in accordance with standard procedures for abandoning and closing wells as set forth by the State Engineers Office.

3.2.3 Soils

All soil samples collected shall be analyzed on a dry weight basis. Surface soil samples (samples collected at a depth of 0-2") collected for human health and ecological risk assessment purposes will be submitted as bulk samples to the laboratory. The laboratory will split the sample into two equal portions. One sample will be archived by the laboratory, and the second half of the bulk sample will be analyzed. Since human health risk is expected to be low or absent, the samples will not be sieved to <250 microns (per discussions with Susan Griffin, EPA, January 8, 2001.)

3.2.3.1 Surface Soil Samples

Surface soils (0-2") will be collected following RMC's SOP 2a, included in this SAP in Appendix C. The surface of the soil will be scraped free of vegetation from the sample location with a shovel, stainless steel spoon, or disposable sampling instrument. The underlying soil sample will then be collected with a stainless steel spoon or gloved hand and placed into a plastic bag, labeled and sealed with a chain-of-custody seal. Coarse-grained soils such as gravel and rock fragments will be discarded. The sample location will be surveyed with either a GPS unit or a licensed land surveyor.

3.2.3.2 Soil Samples at Depth

Samples collected at depth will follow SOP 2b and/or SOP 2c, included in this SAP in Appendix C. Surface vegetation will be scraped away from the sample location with a shovel, stainless steel spoon, or disposable sampling instrument. The target depth increment sample will be collected by one of the following methods: hand-powered auger, soil probe, shovel, or stainless steel trowel. For tailings samples, equipment such as a backhoe or geoprobe will be used as appropriate. This equipment will be operated by a professional operator and arranged for by the Project Manager. All appropriate safety precautions will be taken when working around this equipment. At each increment, the sample will be placed into a glass jar or plastic bag, labeled and sealed with a chain-of-custody seal. The sampling equipment will be decontaminated between each depth increment. If the sampling is to evaluate the cover material over the existing tailings, then the character (color and texture) of the sediment encountered will be noted. The samples will be analyzed in accordance with section 3.4 of this SAP.

This section also applies to sampling of tailings below ground surface. When tailings are encountered for sampling, the resulting exposed tailings will be covered with soil, not tailings. The objective is to not have tailings exposed after sampling.

3.2.4 Sediment Samples

Sediment samples will be collected in accordance with RMC's SOP 4, included in Appendix C. At each of the locations shown on Figure 5, a discrete sample will be collected at the surface and down to a depth of six (6) inches below the surface. Samples will be collected using a hand auger, shovel, or geoprobe methods. All samples will be analyzed as bulk samples.

3.2.5 Background Soil Samples

Background soil samples will be collected in accordance with RMC SOP 2a, included in Appendix C. At each of the locations shown on Figure 2, a discrete sample will be collected from a depth of zero to two inches (0-2") below the ground surface. Any surficial organic matter and debris will be removed prior to sample collection.

3.3 SAMPLE LABELING, HANDLING, CUSTODY, & DOCUMENTATION (B3)

3.3.1 Labeling

Each sample container will be immediately labeled with the following information:

- Project name
- Project number
- Sample identification and location
- Date and time collected
- Analyses requested
- Sampler's initials

Samples will also be labeled as to whether or not they contain any preservatives. Also, their origin will be noted. For example, the sample will be labeled as to whether or not it is tailings, sediment, soils surface or ground water.

Duplicate samples will be given a sample identification number in the same fashion as normal samples such that the laboratory cannot distinguish them as duplicates.

3.3.2 Sample Handling

All samples will be collected in appropriate containers supplied by the laboratory as specified in Table 4, and promptly placed in an iced cooler to maintain a temperature of 4 °C. Typically, samples selected for chemical analysis are delivered at the end of each day to the analytical laboratory. If they are not submitted to the laboratory on the same day collected, they will be refrigerated in a locked sample storage room at RMC's office until delivery to the laboratory.

3.3.3 Chain-of-Custody

Chain-of-custody procedures will be observed and documented. Chain-of-custody documentation will begin in the field for each sample submitted to the laboratory and will also be maintained by laboratory personnel. A chain-of-custody form (Appendix D) will be completed and will accompany each sample cooler to the analytical laboratory.

Sample custody means that all samples will remain in the possession or observation of the sampler at all times, or in a locked facility until delivery to the analytical laboratory.

3.3.4 Documentation

The field personnel will maintain a weather resistant, hardbound sample logbook. The logbook will include the sample identification, sample date, type of sample, and analyses requested. Information specific to the type of sample will also be included, as follows:

- Confirmation Soil Samples - Include the sample number and location to confirm the surveyed location.
- Decontamination Fluid - Include the quantity of water in the sample batch and the type of sampling equipment decontaminated.

3.4 ANALYTICAL METHOD REQUIREMENTS (B4)

Analytical methods, with corresponding laboratory reporting limits (LRLs) are specified on Tables 2 and 2b. Samples will be submitted to American Environmental Consultants Laboratory (AEC) in Salt Lake City, Utah. AEC is certified with the State of Utah. Appendix E contains AEC's QA/QC manual, and certification letters from the Utah Department of Health and Division Bureau of Laboratory Improvement. If another lab performs analyses, it must meet the following criteria and submit all QA documentation to the EPA for approval as described above:

- Demonstrated ability to achieve the required detection limits,
- Certified by the State of Utah, and
- Follows an internal QA/QC program.

If contradictions between the laboratory QA/QC manuals or other documents are identified, information in this SAP supersedes all other documents.

3.5 QUALITY CONTROL REQUIREMENTS (B5)

Quality control will include collecting field duplicates at a rate of 10 percent of the sample load for each sample type, and ensuring that the laboratory runs matrix spike/matrix spike duplicates at a rate of five percent of the sample load for each sample type. The field duplicates will be submitted "blind" to the sample laboratory, i.e., they will be given a separate sample identification number from the environmental sample, unidentifiable to the laboratory, as described above. Field duplicates will be run for the same analytical suite as the environmental samples.

Matrix spikes and matrix spike duplicates will be selected at random by the laboratory. Separate samples do not need to be collected in the field. The laboratory will perform and report all analyses under QA/QC procedures that include the results of method blanks, laboratory control samples, matrix spikes, matrix spike duplicates, and the relative percent difference between the matrix spike sample and duplicate.

Equipment rinsate blanks will be collected during the decontamination process. Equipment rinsate blanks will consist of distilled water rinsate blanks collected from a post-decontamination rinse of soil sampling tools (spoons, shovels, split-spoons, mixing bowls, etc.). At least one equipment rinsate sample will be collected per every twenty field sampling locations or 1 per day, whichever is greater.

Due to the nature of the contaminants at this site, ambient, equipment and trip blanks will not be collected.

3.6 INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE REQUIREMENTS (B6)

All instruments and equipment will be regularly tested, inspected, and maintained according to manufacturers' instructions. Field equipment will be tested and inspected daily before use. Any equipment found to be not functioning properly will be repaired or replaced. Laboratory equipment will be tested, inspected and maintained in accordance with the laboratory QA/QC manual and manufacturers' recommendations.

3.7 INSTRUMENT CALIBRATION & FREQUENCY (B7)

3.7.1 Field Instruments

RMC will follow the manufacturer's specifications to calibrate any field equipment prior to each use. These manufacturers specifications are included in RMC's SOP's. A record of the calibration will be kept in the field logbook.

3.7.2 Laboratory Equipment

Procedures and schedules for the calibration of laboratory equipment are described in the appropriate SW-846 and EPA methods, and in the laboratory's Quality Assurance Plan. These procedures and schedules will be followed for all laboratory work.

3.8 DATA MANAGEMENT (B10)

Data from AEC Laboratory and Frontier Geosciences will be submitted to UPCM in both hard copy and electronic form. To avoid transcription errors, report tables will be prepared directly from the electronic submittals.

4.0 ASSESSMENT / OVERSIGHT (C)

4.1 Assessments and Response Actions (C1)

This section describes the number, frequency, and type of assessment activities needed for this project. Assessments coordinated by the Project QA Officer will include: (1) a readiness review prior to initiating each major phase of field work; (2) surveillance during representative phases of the project; (3) a technical systems audit (TSA) conducted toward the end of the first week of field work; and (4) a data quality assessment (DQA).

The readiness review will be conducted with both the field staff and analytical laboratories as a technical check to determine if the staff, subcontractors, equipment, and record keeping systems are in place to start work in accordance with this QAPP. At the review, the QA Officer will review the project objectives, methodologies, record keeping requirements, and schedule with the field team and laboratories to make sure they are familiar and prepared to meet project requirements. The QA Officer will make sure all systems are ready before field work is initiated.

Surveillance will include weekly reviews of project progress and compliance with QAPP requirements. The project QA Officer will visit the field teams at the Site and observe their work habits and review project records. Based on the surveillance results, the QA Officer may propose corrective actions or changes to the field methods to the Project Manager.

A TSA will be conducted about halfway through the field portion of the project. The TSA is a thorough and systematic on-site qualitative audit where facilities, equipment, personnel, training, procedures, and record keeping and is conducted to determine conformance to the QAPP.

The DQA will be conducted to determine whether the data meet the assumptions that the DQOs and data collection design were developed under and whether the total error in the data are tolerable. This assessment activity will include complete data verification and validation as described in Section 5.0. *Guidance for the Data Quality Assessment Process* (EPA QA/G-9) will be consulted.

The QA Officer will report results of the assessment activities directly to the Project Manager who, with the assistance of the QA Officer, will be responsible for implementing any necessary corrective actions. The occurrence and resolution of major quality issues identified during assessment activities will be documented in memorandum to UPCM, the EPA Project Manager Jim Christiansen, and the UDEQ Project Manager Muhammad Slam.

5.0 DATA VALIDATION AND USABILITY (D)

5.1 Data Review, Validation & Verification Requirements (D1)

The data validation process evaluates whether the specific requirements for an intended use have been fulfilled and ensures that the results conform to the users needs. The data validation process develops the QC acceptance criteria or performance criteria.

Data verification confirms that the requirements of the specified sampling and analytical methods were followed. This process involves reviewing the results of sampling and analysis to determine conformance with the QC requirements described for the project. The data verification process ensures the accuracy of data by using validated methods and protocols, and is often based on comparison with reference standards.

Requirements and methods for data validation and verification are listed in Tables 3, 4, 4b and 4c.

5.2 Validation & Verification Methods (D2)

Data will be reviewed to ensure that the requirements stated in Tables 3 and 4 were met. Data validation and verification will be conducted using the methods described in Table 4. Superfund's working definitions for data verification and validation are as follows:

> Data Validation: A consistent, systematic process that determines whether the data have been collected in accordance to the specification as listed in the approved QAPP. The process is independent of data validation and is conducted at various levels both internal and external to the data generator (laboratory).
>
> Data Validation: An evaluation of the technical usability of the verified data with respect to planned objectives. Data validation is performed external to the data generator (laboratory), using a defined set of performance criteria to a body of data in the evaluation process. This may include checks on some or all of the calculations in the data set and reconstruction of some or all final reported data from initial laboratory data (e.g., chromatograms, instrument printouts). It is in the data validation process that data qualifiers for each verified data are evaluated. It extends beyond the analytical method to protocols or QAPPs to address the overall technical usability of the generated data.

One hundred percent (100%) of the data will be validated according to Table 4 requirements by the Project QA Officer or a subcontractor experienced in conducting this type of data verification. Data will be reviewed as it is received, continuously throughout the project. If problems are uncovered as a result of the validation effort, the QA Officer and Project Manager will be immediately notified. The QA Officer or Project Manager will discuss possible corrective actions with the laboratory prior to implementation. The

Project Manager will immediately notify EPA and UDEQ of any data verification or validation issues that may affect the success of the project.

Any deviations from the analytical control limits specified in Table 3 and 4 will be evaluated in terms of their effect on the data usability. Data usability will be assessed using the National Functional Guidelines for Data Review (Inorganic & Organic, February 1994). The completeness goal for the project is 90 percent valid data.

The results of the data validation and verification will be summarized in a Data Review Report, to be prepared after the completion of sampling and analysis activities at the site.

5.3 RECONCILIATION WITH DATA QUALITY OBJECTIVES (D3)

The data validation and verification results will be compared to the DQOs stated in Table 1 and with the PARCC parameters described in Table 3. This evaluation will summarize the QA/QC performance by PARCC criteria including completeness calculations expressing the percent complete of valid data compared to the total number of samples collected. The result of the data validation and verification will be summarized in the Data Review Report described above.

References

Ecology and Environment, Inc., 1993, Final Report, Richardson Flats Tailings, Summit County, Utah:
Consultant's report prepared for U. S. Environmental Protection Agency, Region VIII, Waste Management
Division, TDD #T08-9204-015 and #T08-9210-050, PAN EUTOO39SBA and EUTOO39SDA.

Resource Management Consultants, Inc., 2000, Focused Remedial Investigation/Feasibility Study Work Plan, UT98095280.

Resource Management Consultants, Inc., 2000, Upper Silver Creek Watershed Analytical Results Report.

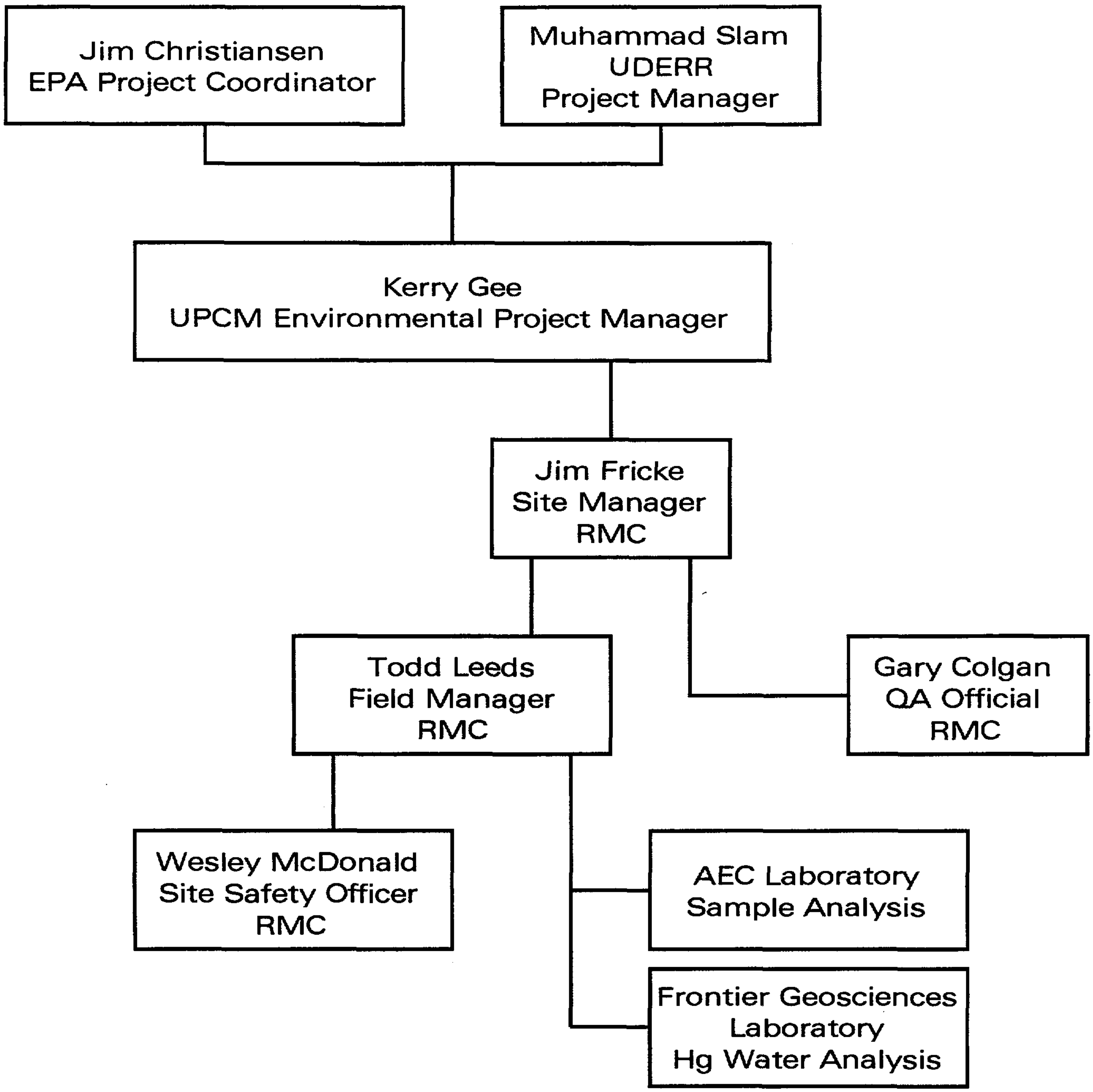
United States Environmental Protection Agency, 1998, EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations, USEPA QA/R-5.

United States Environmental Protection Agency, 1993, EPA Superfund Data Categories.

United States Environmental Protection Agency,1996 Guidance for the Data Quality Assessment Process USEPA QA/G-9.

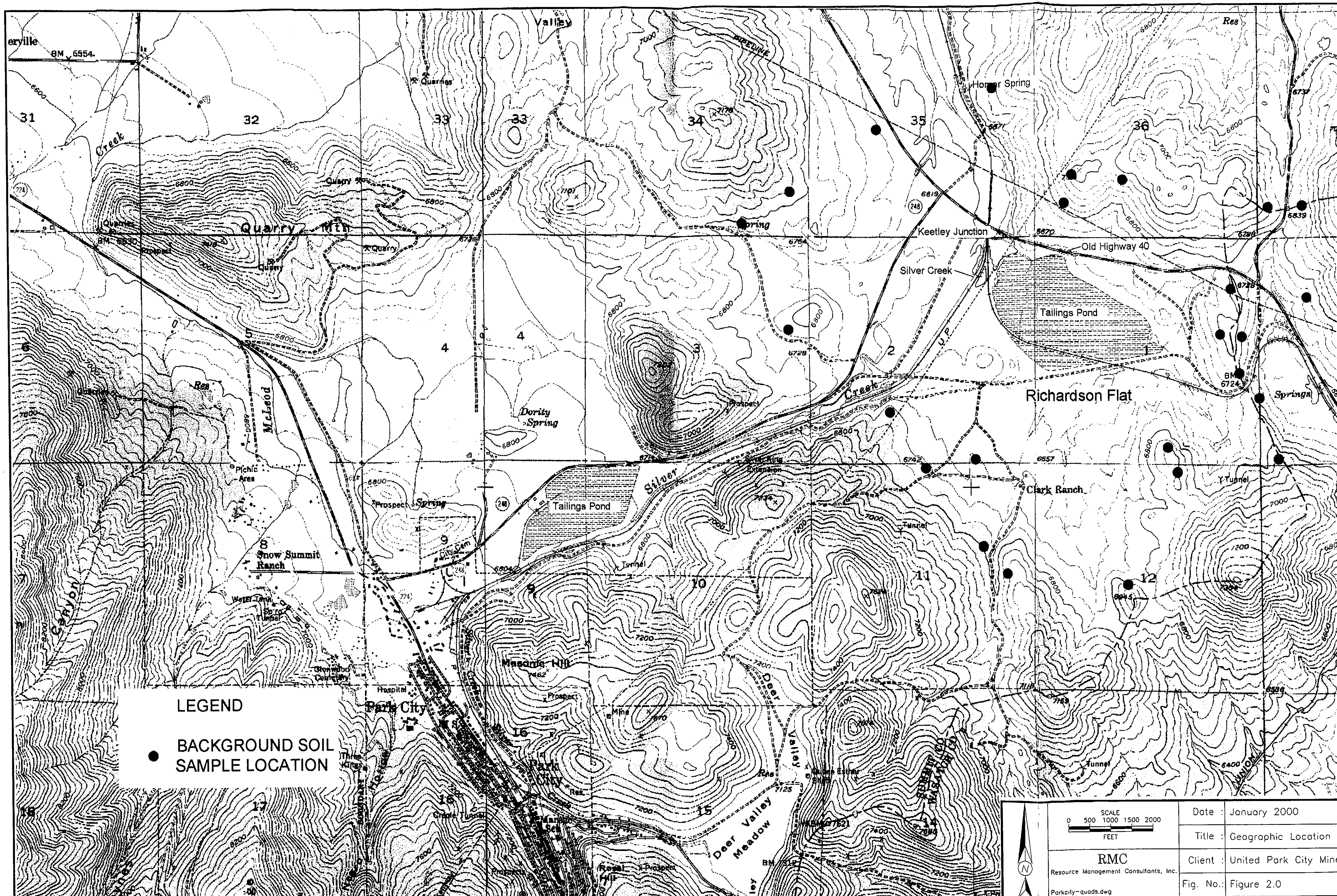
Weston, Inc., 1996, Baseline Risk Assessment, Murray Smelter.

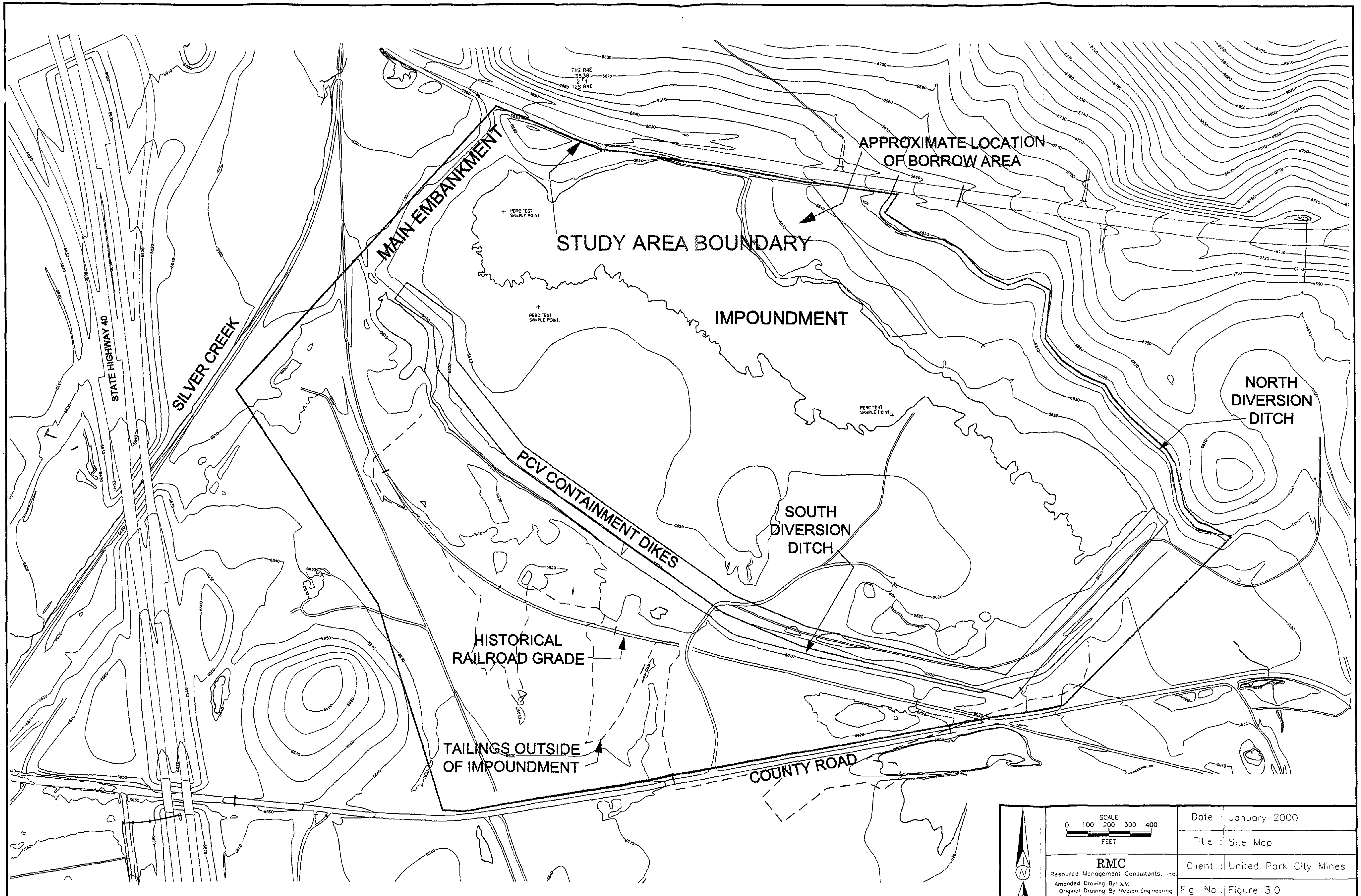
FIGURE 1 - Richardson Flat RI/FS Organizational Chart

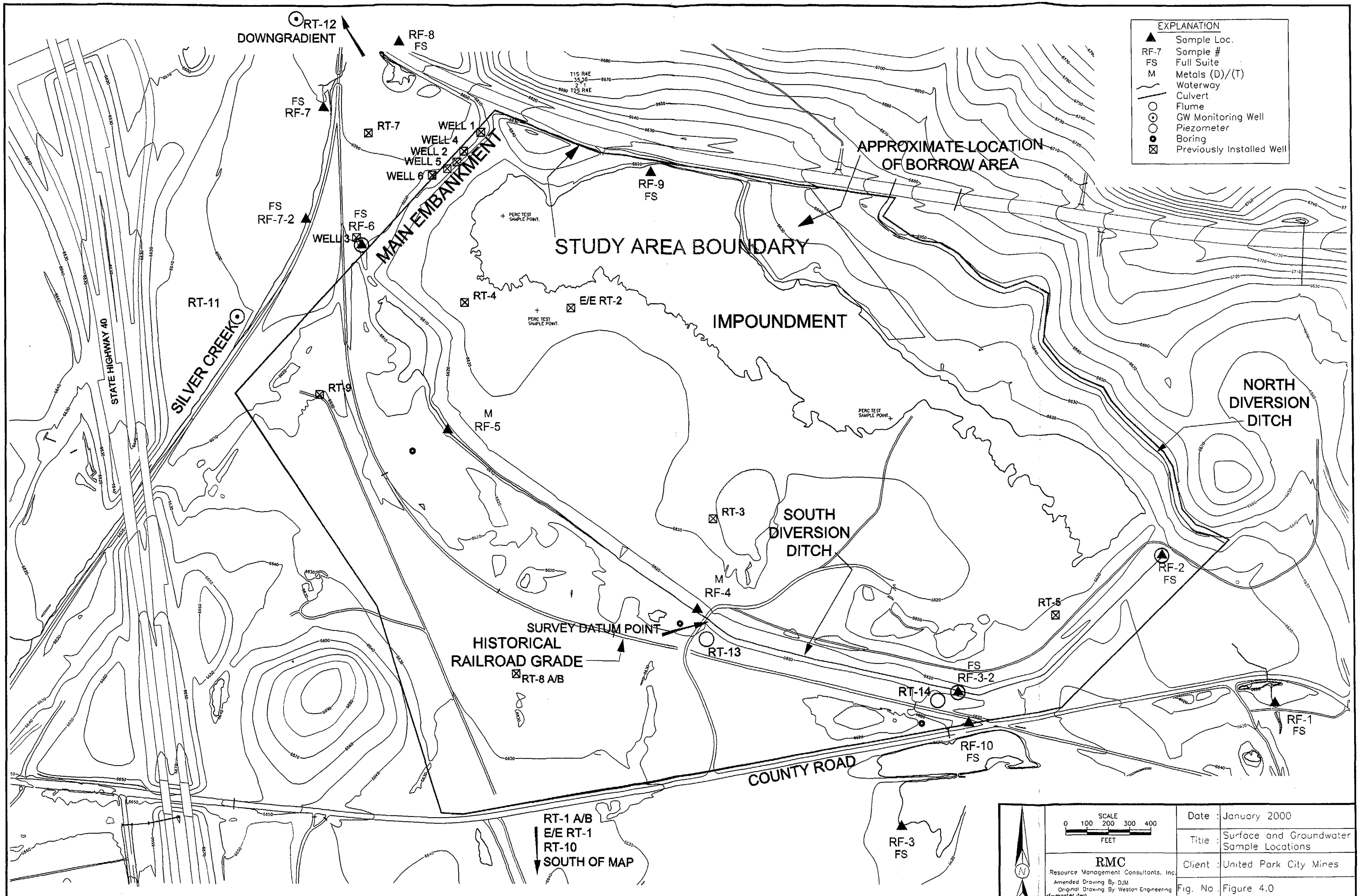


Color Chart(s)

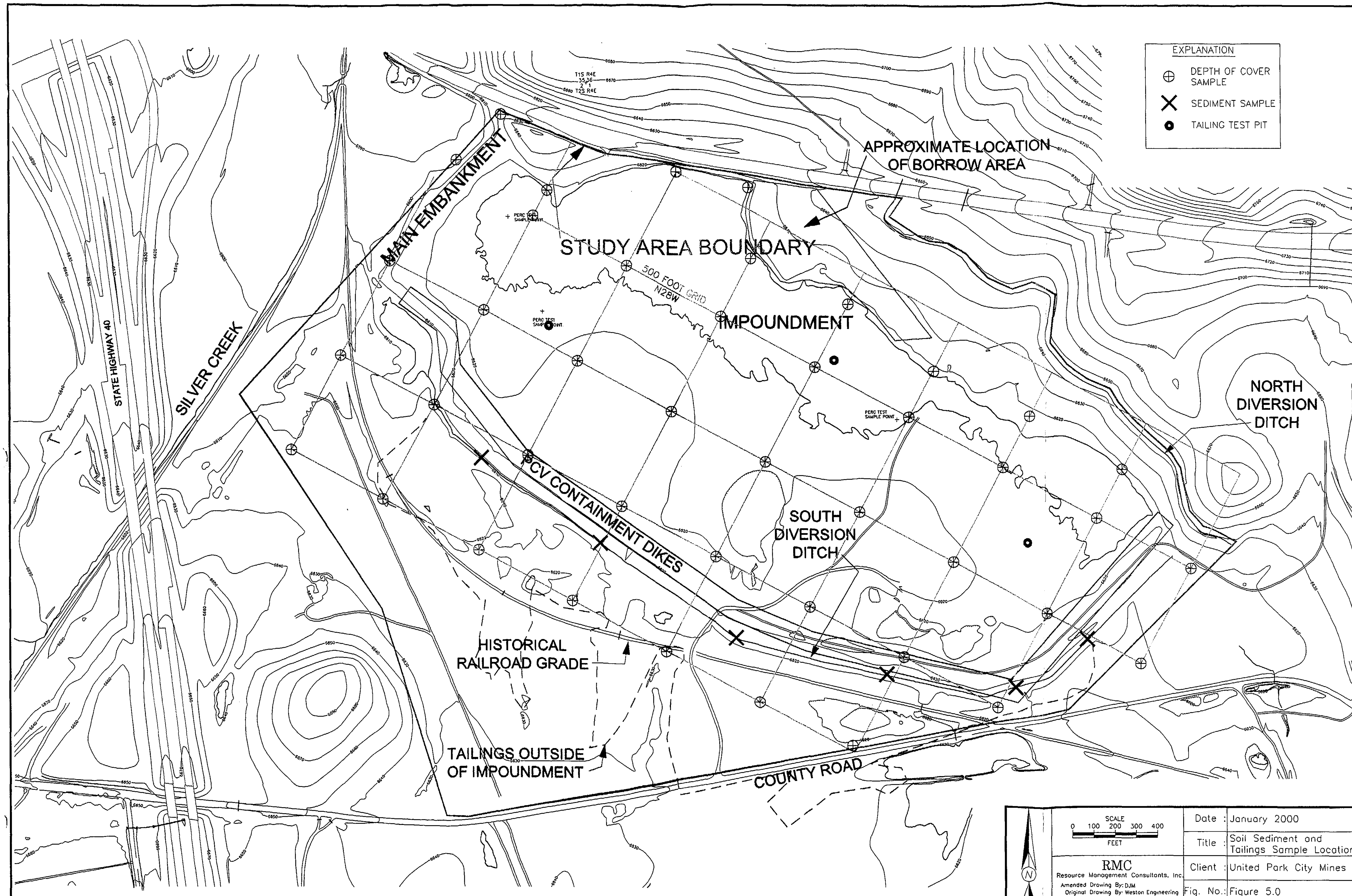
The following charts contain color that does not appear in the scanned images.
To view the actual images please contact the Superfund Record Center at (303) 312-6473.


LEGEND
BACKGROUND SOIL SAMPLE LOCATION
SCALE
0 500 1000 1500 2000
FEET
RMC
Resource Management Consultants, Inc.
Parkcity-quads.dwg
Date : January 2000
Title : Geographic Location
Client : United Park City Mines
Fig. No.: Figure 2.0
Quarry Mtn
Keetley Junction
Old Highway 40
Silver Creek
Tailings Pond
Richardson Flat
Clark Ranch
Snow Summit Ranch
Dority Spring
McLeod
Park City
Masonic Hill
Deer Valley
Deer Valley Meadow
Hospital
Picnic Area
Springs
Res
Valley
Pipeline

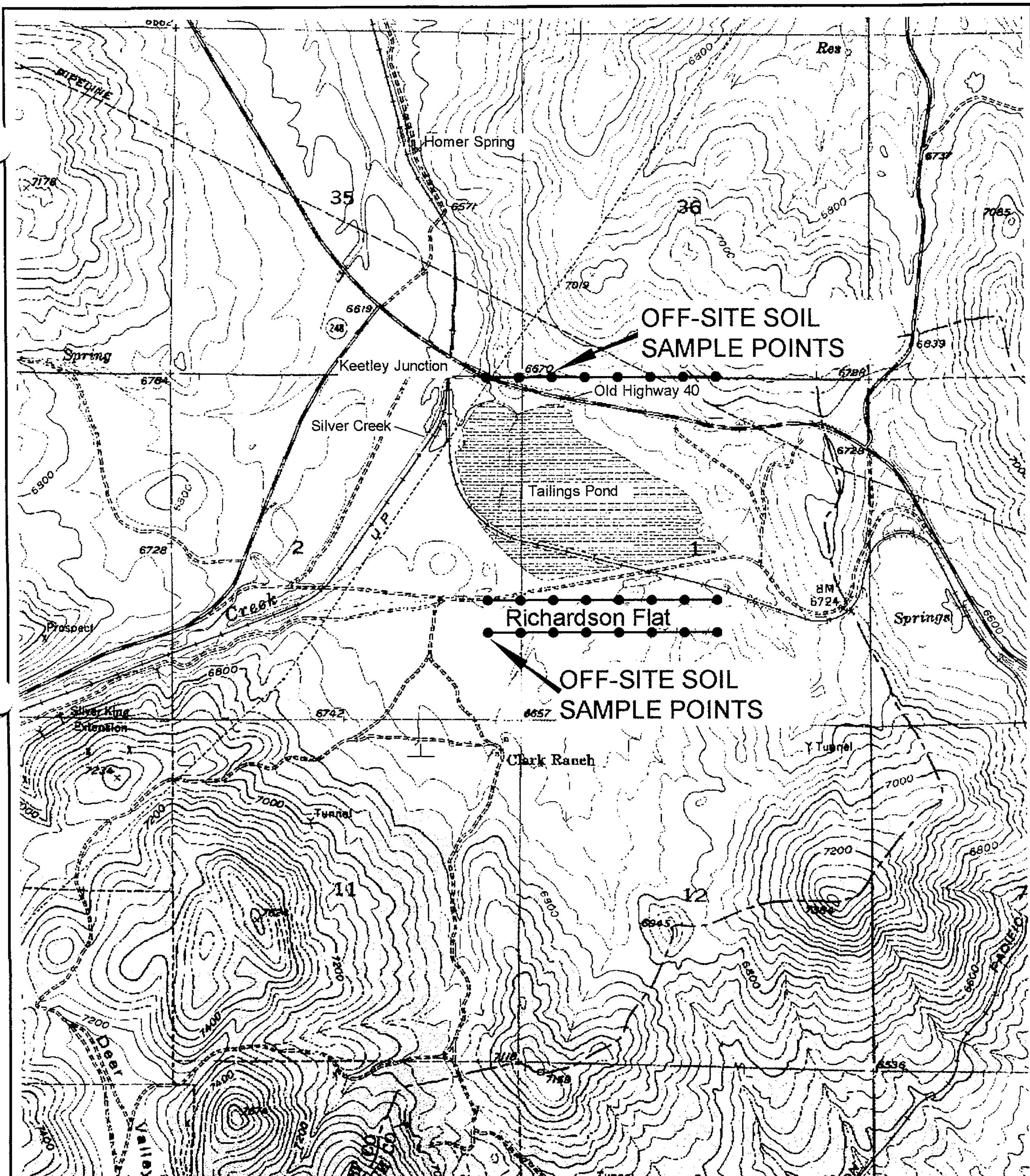

MAIN EMBANKMENT
APPROXIMATE LOCATION
OF BORROW AREA
STUDY AREA BOUNDARY
IMPOUNDMENT
PERC TEST SAMPLE POINT
NORTH
DIVERSION
DITCH
STATE HIGHWAY 40
SILVER CREEK
PCV CONTAINMENT DIKES
SOUTH
DIVERSION
DITCH
HISTORICAL
RAILROAD GRADE
TAILINGS OUTSIDE
OF IMPOUNDMENT
COUNTY ROAD
SCALE
0 100 200 300 400
FEET
RMC
Resource Management Consultants, Inc.
Amended Drawing By: DJM
Original Drawing By Weston Engineering
rf-master.dwg
Date : January 2000
Title : Site Map
Client : United Park City Mines
Fig No. : Figure 3.0



RT-12
DOWNGRADIENT
RF-8
FS
FS
RF-7
RT-7
WELL 1
WELL 4
WELL 2
WELL 5
WELL 6
FS
RF-7-2
FS
RF-6
WELL 3
MAIN EMBANKMENT
RF-9
FS
APPROXIMATE LOCATION OF BORROW AREA
STUDY AREA BOUNDARY
PERC TEST SAMPLE POINT
RT-4
E/E RT-2
IMPOUNDMENT
RT-11
STATE HIGHWAY 40
SILVER CREEK
RT-9
M
RF-5
NORTH DIVERSION DITCH
RT-3
SOUTH DIVERSION DITCH
M
RF-4
RF-2
FS
RT-5
SURVEY DATUM POINT
HISTORICAL RAILROAD GRADE
RT-13
RT-8 A/B
FS
RF-3-2
RT-14
RF-1
FS
RF-10
FS
COUNTY ROAD
RT-1 A/B
E/E RT-1
RT-10
SOUTH OF MAP
RF-3
FS
EXPLANATION
Sample Loc.
RF-7 Sample #
FS Full Suite
M Metals (D)/(T)
Waterway
Culvert
Flume
GW Monitoring Well
Piezometer
Boring
Previously Installed Well
SCALE
0 100 200 300 400
FEET
RMC
Resource Management Consultants, Inc.
Amended Drawing By DJM
Original Drawing By Weston Engineering
rf-master.dwg
Date : January 2000
Title : Surface and Groundwater Sample Locations
Client : United Park City Mines
Fig. No. Figure 4.0



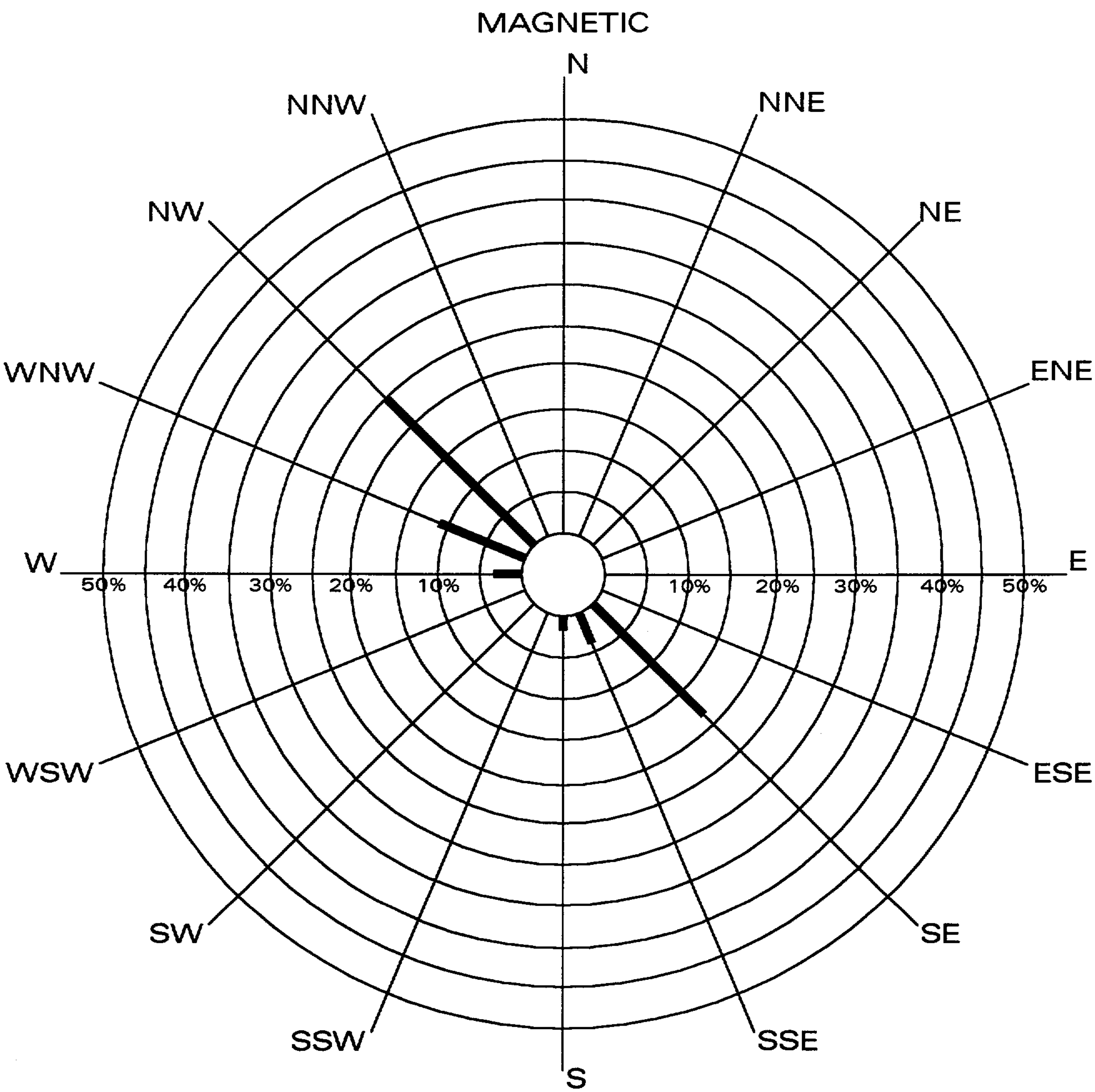
Date :	January 2000
Title :	Soil Sediment and Tailings Sample Locations
Client :	United Park City Mines
Fig. No.:	Figure 5.0



Date	January 2000
Title	Offsite Soil Sampling Locations
Client	United Park City Mines
Fig. No.	Figure 6.0

RMC
Resource Management Consultants, Inc.
Parkcity-quads.dwg

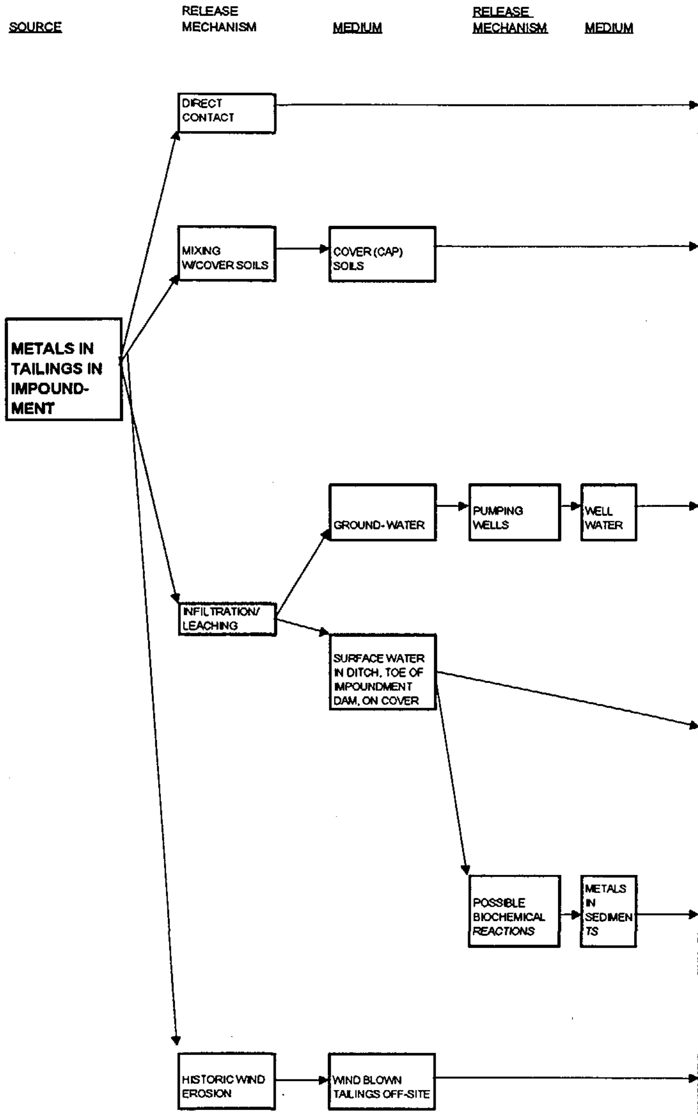
FIGURE 7 - Richardson Flat Wind Rose



DATA COLLECTION DATE: JULY 12, 1986
21.4% CALM

DATA SOURCE: ECOLOGY AND ENVIRONMENT, INC.
ANALYTICAL RESULTS REPORT OF AIR SAMPLING AT RICHARDSON FLAT,
PARK CITY, UT
SEPTEMBER 9,1987
FIGURE 8

FIGURE 8A
RICHARDSON FLAT CONCEPTUAL SITE MODEL

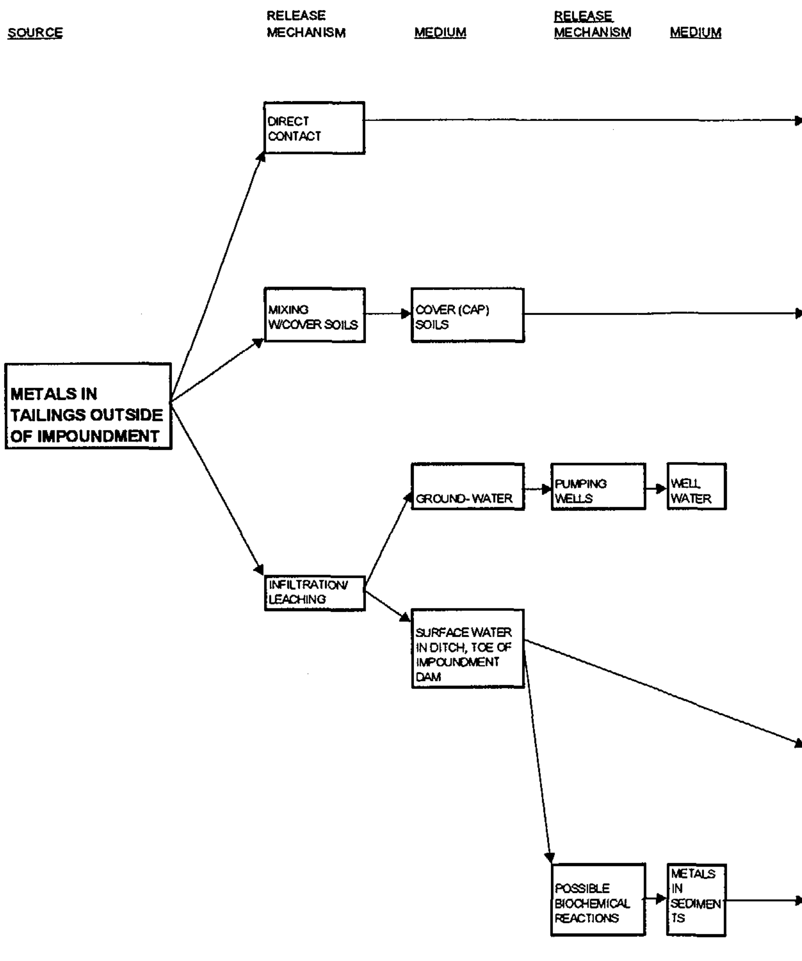


HUMAN RECEPTORS / ECOLOGICAL RECEPTORS

Pathway	Exposure (human)	SITE VISITORS	OFF-SITE RECEPTORS	Exposure (ecological)	WETLAND: AVIAN	WETLAND: INVERTEBRATES	WETLAND: FISH, FROGS, OTHER VERT	WETLAND: PLANTS (VASCULAR, NON)	UPLAND: AVIAN	UPLAND: INVERTEBRATES	UPLAND: MAMMALS, OTHER	UPLAND: PLANTS (VASCULAR, NON)
DIRECT CONTACT	INCIDENTAL INGESTION	—	—	DIRECT EXPOSURE (INGESTION, DERMAL, ROOT UPTAKE)	O	O	O	O	O	O	O	O
	FOOD CHAIN EXPOSURE (FISH)	—	—	FOOD CHAIN EXPOSURE	O	—	O	—	O	—	O	—
COVER (CAP) SOILS	INCIDENTAL INGESTION	-	-	DIRECT EXPOSURE (INGESTION, DERMAL, ROOT UPTAKE)	O	O	O	O	O	O	O	O
	FOOD CHAIN EXPOSURE (FISH)	-	-	FOOD CHAIN EXPOSURE	O	—	O	—	O	—	O	—
WELL WATER	INCIDENTAL INGESTION	—	O	DIRECT EXPOSURE (INGESTION, DERMAL, ROOT UPTAKE)	—	—	—	—	—	—	—	—
	FOOD CHAIN EXPOSURE (FISH)	—	—	FOOD CHAIN EXPOSURE	—	—	—	—	—	—	—	—
SURFACE WATER	INCIDENTAL INGESTION	O	—	DIRECT EXPOSURE (INGESTION, DERMAL, ROOT UPTAKE)	●	●	●	●	●	—	●	●
	FOOD CHAIN EXPOSURE (FISH)	O	—	FOOD CHAIN EXPOSURE	●	—	●	—	O	—	O	—
METALS IN SEDIMENTS	INCIDENTAL INGESTION	O	—	DIRECT EXPOSURE (INGESTION, DERMAL, ROOT UPTAKE)	●	●	●	●	O	—	O	O
	FOOD CHAIN EXPOSURE (FISH)	—	—	FOOD CHAIN EXPOSURE	●	—	●	—	O	—	O	—
WIND BLOWN TAILINGS OFF-SITE	INCIDENTAL INGESTION	—	O	DIRECT EXPOSURE (INGESTION, DERMAL, ROOT UPTAKE)	—	—	—	—	O	O	O	O
	FOOD CHAIN EXPOSURE (FISH)	—	—	FOOD CHAIN EXPOSURE	—	—	—	—	O	—	O	—

KEY	
●	POTENTIALLY SIGNIFICANT
--	PATHWAY INCOMPLETE, NO FURTHER EVALUATION
O	POTENTIAL PATHWAY
BLANK	NOT APPLICABLE

FIGURE 8B
RICHARDSON FLAT CONCEPTUAL SITE MODEL



Direct contact

HUMAN RECEPTORS	SITE VISITORS	OFF-SITE RECEPTORS
INCIDENTAL INGESTION	O	--
FOOD CHAIN EXPOSURE(FISH)	--	--

ECOLOGICAL RECEPTORS	WETLAND: AVIAN	WETLAND: INVERTEBRATES	WETLAND: FISH, FROGS	WETLAND: PLANTS (VASCULAR, NON)	UPLAND: AVIAN	UPLAND: INVERTEBRATES	UPLAND: MAMMALS, OTHER	UPLAND: PLANTS (VASCULAR, NON)
DIRECT EXPOSURE (INGESTION, DERMAL,ROOT UPTAKE)	O	O	O	O	●	●	●	●
FOOD CHAIN EXPOSURE	O	--	O	--	●	--	●	--

Cover (cap) soils

	SITE VISITORS	OFF-SITE RECEPTORS
INCIDENTAL INGESTION	-	-
FOOD CHAIN EXPOSURE(FISH)	-	-

	AVIAN	INVERTEBRATES	FISH, FROGS, OTHER VERT	PLANTS (VASCULAR, NON)	AVIAN	INVERTEBRATES	MAMMALS, OTHER	PLANTS (VASCULAR, NON)
DIRECT EXPOSURE (INGESTION, DERMAL,ROOT UPTAKE)	O	O	O	O	O	O	O	O
FOOD CHAIN EXPOSURE	O	--	O	--	O	--	O	--

Well water

(INSIGNIFICANT CONTRIBUTION DUE TO LOW VOLUME RELATIVE TO IMPOUNDMENT)

Surface water

	SITE VISITORS	OFF-SITE RECEPTORS
INCIDENTAL INGESTION	O	--
FOOD CHAIN EXPOSURE(FISH)	O	--

	AVIAN	INVERTEBRATES	FISH, FROGS, OTHER VERT	PLANTS (VASCULAR, NON)	AVIAN	INVERTEBRATES	MAMMALS, OTHER	PLANTS (VASCULAR, NON)
DIRECT EXPOSURE (INGESTION, DERMAL,ROOT UPTAKE)	●	●	●	●	●	--	●	●
FOOD CHAIN EXPOSURE	●	--	●	--	O	--	O	--

Metals in sediments

	SITE VISITORS	OFF-SITE RECEPTORS
INCIDENTAL INGESTION	O	--
FOOD CHAIN EXPOSURE(FISH)	--	--

	AVIAN	INVERTEBRATES	FISH, FROGS, OTHER VERT	PLANTS (VASCULAR, NON)	AVIAN	INVERTEBRATES	MAMMALS, OTHER	PLANTS (VASCULAR, NON)
DIRECT EXPOSURE (INGESTION, DERMAL,ROOT UPTAKE)	●	●	●	●	O	--	O	O
FOOD CHAIN EXPOSURE	●	--	●	--	O	--	O	--

KEY	
●	POTENTIALLY SIGNIFICANT
--	PATHWAY INCOMPLETE, NO FURTHER EVALUATION
O	POTENTIAL PATHWAY
BLANK	NOT APPLICABLE

TABLES

Data Quality Objectives, Uses, Types and QC Levels

Sample Collection Guide – Target Analytes and Collection Requirements

Rationale for Proposed Laboratory Reporting Limits

PARCC

Data Validation and Verification Requirements

Data Flagging Convention for Metals Analyses

Data Flagging Convention for Ion Chromatography and Wet Chemistry

Sample Locations, Media and Target Analytes

Table 1
Data Quality Objectives, Data Uses, Data Type, and QC levels
Richardson Flat
Sampling and Analysis Plan

Data Quality Objectives	Conceptual Site Model Exposure Pathway or Other Evaluation	Existing Data Summary	Data Use	Data Needs	Analysis Type	QC Level
Background Soil Sampling	Comparison of pathways exposures to natural background	Limited soil data from off-site, upland areas; water data from nearby areas	Evaluate whether potential risk exceeds existing, naturally occurring background exposures	Sampling of natural surface soils in area surrounding site	Soil analysis	Definitive
Biological assessment of tailings and vicinity	Identification of ecological receptors of concern	Highway species survey, county surveys	Problem formulation phase of ecological risk assessment	Survey of typical, endangered, and threatened species on site and in affected off-site areas	Site-specific field survey conducted by trained biologists	Definitive
Sample tailings on and near impoundment	Direct contact with tailings outside of the impoundment	Lacking	Evaluate human health, upland ecological receptor risk	Metals concentrations, aerial extent of covered and uncovered tailings	Soil (tailings) samples	Definitive
Surface water sampling	Outside-impoundment tailings contribution to surface water	Preliminary	Evaluate source contribution for remediation purposes. Augment previous data.	Water quality analysis, pH Measurement	Water quality analysis pH Measurement	Definitive Screening
Tailings soil cover sampling	Mixing of cover soils with tailings	Lacking although cover soils were obtained from clean sources	Evaluate potential risk, particularly ecological risk. Evaluate existing soil cover.	Inspect cover for potential mixing; Sample cover soils in thin areas	Soil analysis	Definitive
Groundwater sampling and assessment	Contact with groundwater by humans or through seeps or surfacing of groundwater	Groundwater report is forthcoming. existing data do not indicate potential for vertical migration of metals or impacts on off-site water wells	Evaluate potential human exposure; Confirm lack of elevated metals concentrations in seeps and surface water	Off-site well surveys	Investigation	Definitive
Surface water sampling	Contact with surface water	Water quality data for diversion ditch and Silver Creek	Evaluate wetland processes that remove metals from water	Water quality analysis, pH Measurement	Water quality analysis pH measurement	Definitive Screening
Sample sediment in south diversion ditch	Contact with sediments	Metals data for sediments in wetland	*If sediment concentrations exceed* ecological risk screening levels additional data may be needed	Obtain sediment samples from diversion ditch	*Soil metals analysis (dry* weight) of surficial sediments and sediments in biotic zone	Definitive
Sample offsite tailings	Contact with wind-blown tailings	Limited to knowledge that dust storms occurred	Determine extent of windblown tailings and resulting soil metals concentrations	Tiered sampling plan to delineate extent and estimate concentrations	Soil analysis of surface soil samples	Definitive

TABLE 2

Sample Collection Guide - Target Analytes and Collection Requirements
Richardson Flat
Sample and Analysis Plan

Soils[5]

Parameters	Method	LRL[2]	Container	Volume[4]	Temperature	Preservative	Hold Days
Ag,Al,As,Cr,Cu,Fe,Pb,Sb,Se,Zn	SW-846 6010B	5 ppm	Glass Jar or Plastic Bag	4 oz.	4°C	N/A	180
Cd	SW-846 6010B	0.5 ppm	Glass Jar or Plastic Bag	4 oz.	4°C	N/A	180
Mercury	SW-846 7471	0.1 ppm	Glass Jar or Plastic Bag	4 oz.	4°C	N/A	28
Moisture Content		0.10%	Glass Jar or Plastic Bag	4 oz.	4°C	N/A	

Water

Parameters[1]	Method	LRL[3]	Container	Volume[4]	Temperature[6]	Preservative	Hold Days
pH (Field)	EPA 150.1	NA	Polyethylene	Bottle 5	4°C	None	1
Ag,As,Cd,Cu,Mn,Pb,Sb,Se (Total & Dissolved)	SW-846 6010B or 6020	0.005	Polyethylene	Bottle 1,2	4°C	2 ml HNO_3 (ph<2)	180
Cd (Total & Dissolved)	SW-846 6010B or 6020	0.001	Polyethylene	Bottle 1,2	4°C	2 ml HNO_3 (ph<2)	180
Se (Total & Dissolved)	SW-846 6010B or 6020	0.004	Polyethylene	Bottle 1,2	4°C	2 ml HNO_3 (ph<2)	180
Cr (Total & Dissolved)	SW-846 6010B or 6020	0.01	Polyethylene	Bottle 1,2	4°C	2 ml HNO_3 (ph<2)	180
Al (Total & Dissolved)	SW-846 6010B or 6020	0.05	Polyethylene	Bottle 1,2	4°C	2 ml HNO_3 (ph<2)	180
Zn (Total & Dissolved)	SW-846 6010B or 6020	0.01	Polyethylene	Bottle 1,2	4°C	2 ml HNO_3 (ph<2)	180
Fe (Total & Dissolved)	SW-846 6010B or 6020	0.1	Polyethylene	Bottle 1,2	4°C	2 ml HNO_3 (ph<2)	180
Hg (Total & Dissolved)	EPA 245.1	0.0002	Polyethylene	Bottle 1,2	4°C	2 ml HNO_3 (ph<2)	28
Hg (Total & Dissolved)	EPA 1631B	0.000001	Polyethylene	Bottle 1,2	4°C	2 ml HNO_3 (ph<2)	28
Ca, K, Mg, Na	SW-846 6010B	2	Polyethylene	Bottle 2	4°C	None	180
Cl	EPA 325.2	1	Polyethylene	Bottle 3	4°C	None	28
NO_3, NO_2	EPA 353.2	0.1	Polyethylene	Bottle 4	4°C	H_2SO_4	28
CO_3, HCO_3	EPA 310.1	1	Polyethylene	Bottle 3	4°C	None	14
NH_3	EPA 350.1	0.1	Polyethylene	Bottle 4	4°C	H_2SO_4	28
Total P	EPA 365.4	0.1	Polyethylene	Bottle 4	4°C	H_2SO_4	28
SO_4	SW-846 9036	2	Polyethylene	Bottle 3	4°C	None	28
Alkalinity	EPA 310.1	1	Polyethylene	Bottle 3	4°C	None	14
Conductivity	Digital Meter	10 uS	Polyethylene	Bottle 5	4°C	None	28
Hardness	2340B[5]	N/A	Polyethylene	Bottle 3	4°C	None	180
Cation/Anion Balance	Calculation	N/A	Polyethylene	N/A	4°C	None	NA
TSS	EPA 160.2	1	Polyethylene	Bottle 3	4°C	None	7
TDS	EPA 160.1	10	Polyethylene	Bottle 3	4°C	None	7

N/A - Not Applicable
LRL - Laboratory Reporting Limit
[1] Field Data Collected for each sample station/event includes:
pH, Conductivity, Temperature, Flow
[2] All units are Parts Per Million (ppm) based upon dry weight unless otherwise noted.
[3] All units in mg/l except as noted.
[4] Laboratory analysis for the above parameters will require collection of the following sample volumes/preservation at each sample station:

Bottle 1 - 500 ml bottle filtered to 0.45μm and preserved with 2 ml HNO_3
Bottle 2 - 500 ml bottle unfiltered and preserved with 2 ml HNO_3
Bottle 3 - 1000 ml bottle unfiltered and unpreserved
Bottle 4 - 500 ml bottle unfiltered and preserved with 2 ml H_2SO_4
Bottle 5 - 500 ml bottle unfiltered and unpreserved for field parameters.

[5] Standard Methods, 20th edition
[6] Laboratory will measure the temperature of each cooler upon receipt to ensure proper temperature was maintained (4°C +/- 2°C)

Table 2b
Rationale for Proposed Laboratory Reporting Limits

Sediment/Soil						
Parameters	Method	Consensus-Based Threshold Effect Concentrations (TEC)[1] (mg/kg)	Consensus-Based Probable Effect Concentrations (PEC)[1] (mg/kg)	Other Criteria	Explanation for "Other Criteria"	LRL (ppm)
Ag	SW-846 6010B			4.5	Toxicity Threshold[4]	5
Al	SW-846 6010B			2.55%	Lowest threshold effect level[4]	5
As	SW-846 6010B	9.79	33.0			5
Cd	SW-846 6010B	0.99	4.98			0.5
Cr	SW-846 6010B	43.4	111			5
Cu	SW-846 6010B	31.6	149			5
Fe	SW-846 6010B					5
Hg	SW-846 7471	0.18	1.06			0.1
Pb	SW-846 6010B	35.8	128			5
Sb	SW-846 6010B			3	Upper effects threshold[4]	5
Se	SW-846 6010B			4	Toxicity Threshold[5]	5
Zn	SW-846 6010B	121	459			5
Water						
Parameters	Method	Aquatic Wildlife Criteria (chronic)[2] (mg/l)	Aquatic Wildlife Criteria (acute)[2] (mg/l)	Utah WQS for Stream Class. IC[2] (mg/l)	Drinking Water MCL[3] (mg/l)	LRL (mg/l)
Ag	SW-846 6010B or 6020	N/A	0.072	0.05	0.05	0.005
As	SW-846 6010B or 6020	0.19	0.36	0.05	0.05	0.005
Cd	SW-846 6010B or 6020	0.003	0.016	0.01	0.005	0.001
Cr	SW-846 6010B or 6020	0.572	4.8	0.05	0.1	0.01
Cu	SW-846 6010B or 6020	0.033	0.055	1	1.3 (TTR)	0.005
Fe	SW-846 6010B or 6020				0.3 (Secondary)	0.1
Hg	EPA 245.1	0.000012	0.0024	0.002	0.002	0.0002
Hg	SW-846 1631B (RF-4,6,8)	0.000012	0.0024	0.002	0.002	0.000001
Mn	SW-846 6010B or 6020				0.05 (Secondary)	0.005
Pb	SW-846 6010B or 6020	0.015	0.375	0.05	0.015 (TTR)	0.005
Sb	SW-846 6010B or 6020				0.006	0.005
Se	SW-846 6010B or 6020	0.005	0.02	0.01	0.05	0.004
Zn	SW-846 6010B or 6020	0.292	0.322	none	none	0.01

[1] Consensus-based sediment quality guidelines for freshwater ecosystems (MacDonald et al., 2000, Arch. Contam. Toxicology)

[2] Lowest values (based on hardness) listed in Table 3.4 of *Focused RI/FS Workplan for Richardson Flat Tailings Site* (RMC, 1999)

[3] Safe Drinking Water Act Primary Maximum Contaminant Levels (MCLs), Secondary Drinking Water Standard, or Treatment Technique Requirement (TTR)

[4] Screening Quick Reference Table for Inorganics in Freshwater Sediments (NOAA, 1999)

[5] DOI *Guidelines for Interpretation of the Biological Effects of Selected Constituents in Biota, Water, and Sediment* (1998)

TABLE 3
Precison, Accuracy, Representativeness, Comparability and Completeness (PARCC)
Richardson Flat
Sample and Analysis Plan

Parameter	QC Program	Evaluation Criteria	Acceptance Criteria	Recommended Corrective Actions
Precision	Field Duplicate	Relative Percent Difference (RPD)	RPDs: soil, sediment and water samples +/- 35 percent if > 5 times LRL, or, +/- LRL if < 5 times LRL	Verify the RPD calculation. If correct, determine if matrix interference or heterogeneous samples are factors in poor RPD. If matrix effects or heterogeneous samples are not observed, reanalyze the associated investigative samples and MS/MSD. If appropriate, reextract or redigest and reanalyze the associated investigative samples and MS/MSD.
	Matrix Spike/Matrix Spike Duplicate (MS/MSD)	Relative Percent Difference (RPD)	See method-specific control limits[1]	Verify the RPD calculation. If this is correct, determine if matrix interference or heterogeneous samples are factors in poor RPD. If matrix effects or heterogeneous samples are not observed, reanalyze the method duplicate and associated investigative samples.
Accuracy	Matrix Spike (MS)	Percent Recovery	See method-specific control limits[1]	Verify the matrix spike percent recovery calculations and evaluate the LCS percent recovies. If the calculations are correct and the LCS recoveries are acceptable, determine if matrix interference is a factor in the poor recoveries. If matrix effects not observed, reanalyze the MS and associated samples. If appropriate, reextract or redigest and reanalyze the MS and associated investigative samples.
	Matrix Spike Duplicate (MSD)	Percent Recovery	See method-specific control limits[1]	Same as above.
	Laboratory Control Samples (LCS)	Percent Recovery	See method-specific control limits[1]	Verify the percent recovery calculations. Evaluate the standard to determine if it is faulty. If it is, prepare a new standard and reanalyze the LCS and associated investigative samples. If necessary, recalibrate the instrument. Do not continue analysis until problem solved.
Representativeness	Holding Times	Representative of Environmental Conditions	Holding Times Met 100 Percent	Evaluate whether data is critical to decision making. If so, resample and reanalyze for parameter exceeding holding time.
	Method Blanks	Qualitative Degree of Confidence	See method specific requirements[1]	Evaluate instrument, locate source of contamination, perform system blanks to confirm that system blanks meet performance criteria. Re-analyze method blank and associated samples. If method blank still above acceptance criteria, reextract or redigest the method blank and all associated samples.
	Equipment/Rinsate Blanks	Qualitative Degree of Confidence	Target analytes <1 X LRL; 5-10 X LRL for laboratory-inducted contaminants.	Suggests field sampling-induced contamination may have occurred. Evaluate all associated QC samples. If all other QC samples are within prescribed acceptance limits, but equipment blank is not (e.g., positive identification of target analytes observed), contact USEPA immediately to determine if resampling and/or reanalysis required.
	Field Duplicates	Qualitative Degree of Confidence	90 Percent of Field Duplicates Meet RPD Goals	If acceptance criteria not met, evaluate reasons for not meeting criteria (i.e., matrix interferences or heterogeneous samples) and make recommendations on whether resampling and/or reanalysis is necessary to improve degree of confidence.
Comparability	Standard Units of Measure	Qualitative Degree of Confidence	Laboratory Methods Followed	Revise analytical reports with correct units.
	Standard Analytical Methods		SOPs Followed	If SOPs not followed, evaluate whether reanalysis is necessary to obtain reliable data.
Competeness	Complete Sampling	100 Percent Valid[2] Samples	90 Percent Valid[2] Data	If not enough samples were collected for project needs, collect and analyze additional samples for parameters needed for key decisions.

[1] Laboratory Control limits are specific to individual analytical/digestion methods and any deviation outside control limits are reported (see method-specific SOPs in Appendix F).
[2] Valid means that samples meet all evaluation criteria (i.e., are not rejected for any reason).

Precision is a measure of how repeatable data are and is often measured by sample duplicates.
Accuracy is a measure of how close the data are to the actual, or real value, measured by certified reference materials and matrix spikes.
Representativeness is a measure of how representative a sample is of the sample population and is achieved by accurate sampling procedures and appropriate sample homogenization.
Comparability looks at ongoing projects and how variable one set of data is relative to another. Comparability helps to measure the scientific consistency of the system to past work.
Completeness is a measure of how many data points collected are usable; 90% usable data is considered to be an acceptable value for completeness.

TABLE 4
Data Validation and Verificaiton Requirements
Richardson Flat
Sample and Analysis Plan

Data Validation and Verification Steps		Data Validation and Verification Methods
Samples were collected according to established locations and frequencies.	→	Comparison with Sampling Plan
Sample collection and handling followed established procedures.	→	Review of field notes, field procedures and COCs
Appropriate analytical methods were used; internal laboratory calibration checks were performed according to the method-specified protocol.	→	Review of analytical methods and case narratives provided with laboratory reports. Documentation of any communications with laboratory concerning problems or corrective actions.
Required holding times and laboratory reporting limits were met.	→	Comparison with established holding times and LRLs.
Field Duplicates for QA/AC	→	Field duplicates met acceptance criteria tabulation of RPDs and comparison with PARCC parameters
Acceptance criteria (see Table 3) for field and laboratory QC samples (field blanks, field dups, equipment/rinsate blanks, method blanks, LCS) were met.	→	Tabulation of RPDs and spike recoveries, and direct comparison with method-specific acceptance criteria (see SOPs in Appendix F). Comparison with PARCC parameters.
Appropriate steps were taken to ensure the accuracy of data reduction, including reducing data transfer errors in the preparation of summary data tables and maps.	→	Maintain permanent file for laboratory hardcopies of analysis reports. Minimize retyping of data and error check data entered into database, tables, maps, etc.

RPD = Relative Percent Difference
LRL = Laboratory Reporting Limit

TABLE 4b
Data Flagging Convention for Metals Analyses

QUALITY CONTROL ITEM	EVALUATION	DATA QUALIFIER FLAG			SAMPLE(S) QUALIFIED
		Detects		Nondetects	
		Non Biased	Biased		
HOLDING TIMES	1) Holding time exceeded by 2 times or less 2) Holding time exceeded by greater than 2 times	J J	J- J-	UJ R	Sample
METHOD BLANK CONTAMINATION	Sample results less than or equal to 5 times the blank contamination	U	U	No qual.	All samples in the same Preparation Batch
MATRIX SPIKE RECOVERY	1) % Recovery < CL but ≥ 30% 2) % Recovery <30% 3) % Recovery > CL 4) RPD > CL	J J J J	J- J- J+ J	UJ R No qual. UJ	All samples in the same Method Batch
LABORATORY CONTROL SAMPLE RECOVERY	1) % Recovery < CL but ≥ 50% 2) % Recovery <50% 3) % Recovery > CL 4) RPD > CL	J J J J	J- J- J+ J	UJ R No qual. UJ	All samples in the same Preparation Batch
REPORTING LIMITS	1) Reporting limits not matching the project specified limits 2) Reported result less than the project reporting detection limit.	No qual. J	No qual. J	No qual. No qual.	Sample (noted in outlier report) Sample
FIELD DUPLICATES	RPD > CL	No qual.	No qual.	No qual.	Non-compliant results listed in the ADR outlier report
FIELD BLANKS EQUIPMENT BLANKS	Sample results within 5 times blank contamination	U	U	No qual.	All samples in the same sampling event

TABLE 4c
Data Flagging Convention for Ion Chromatography and Wet Chemistry

QUALITY CONTROL ITEM	EVALUATION	DATA QUALIFIER FLAG			SAMPLE(S) QUALIFIED
		Detects			
		Non Biased	Biased	Nondetects	
HOLDING TIMES	1) Holding time exceeded by 2 times or less	J	J-	UJ	Sample
	2) Holding time exceeded by greater than 2 times	J	J-	R	
METHOD BLANK CONTAMINATION	Sample results less than or equal to 5 times the blank contamination	U	U	No qual.	All samples in the same Preparation Batch
MATRIX SPIKE RECOVERY	1) % Recovery < CL but ≥ 30%	J	J-	UJ	All samples in the same Method Batch
	2) % Recovery <30%	J	J-	R	
	3) % Recovery > CL	J	J+	No qual.	
	4) RPD > CL	J	J	UJ	
LABORATORY CONTROL SAMPLE RECOVERY	1) % Recovery < CL but ≥ 50%	J	J-	UJ	All samples in the same Preparation Batch
	2) % Recovery <50%	J	J-	R	
	3) % Recovery > CL	J	J+	No qual.	
	4) RPD > CL	J	J	UJ	
REPORTING LIMITS	1) Reporting limits not matching the project specified limits	No qual.	No qual.	No qual.	Sample (noted in outlier report)
	2) Reported result less than the project reporting detection limit.	J	J		Sample
FIELD DUPLICATES	1) RPD > CL	No qual.	No qual.	No qual.	Non-compliant results listed in the ADR outlier report
FIELD BLANKS EQUIPMENT BLANKS	Sample results within 5 times blank contamination	U	U	No qual.	All samples in the same sampling event

TABLE 5

Sample Locations, Media and Target Analytes

Richardson Flat Sample and Analysis Plan

Location	Media	Analytes	Location Description	Objectives
Impoundment	Surface Water	List 3	Surface water samples at RF-1,RF-2,RF-3-2,RF-4,RF-5,RF-6-2,RF-7-2,RF-8, monthly frequency, see Fig.4 for locations	Collect data in silver Creek and in drainages associated with the site to aid in determination of the background water quality relative to the site and the sites' impact on water quality in Silver Creek, including seasonal variation. Provide additional surface water data for comparison with human health and ecological screening levels.
Site	Groundwater	List 3	Ground water samples on monitoring wells completed in Silver Creek alluvium, downstream and upstream of Site.	Determine metal concentrations in the Silver Creek shallow alluvial ground water both up and down stream of the impoundment. Collect surface and ground water elevation data to quantify the interaction between shallow ground water and Silver Creek, including seasonal variations.
Impoundment	Soils	List 1	Tailing cover, visual with laboratory confirmation at 10% of locations. Approximately 42 locations, see Fig 5.	Determine metal concentrations in imported cover soils, provide data of sufficient quality and quantity for analyzing risks to human health and for comparison with ecological screening levels and background. Verify extent of imported soil cover in tailings. Determine suitability of the soil cover to minimize surface water infiltration into the tailings.
Diversion Ditch	Soils - Sediments	List 2	Sediment Samples in the south diversion ditch. Approximately 6 locations, see Fig. 5.	Collect sediment data in the south diversion to aid in the identification of the location of metal loading in the ditch. Use the data to determine long-term chemical fate and stability of metals in the sediments and in ecological risk assessment.
Impoundment	Tailings	List 2	Tailings below cover, three test pits, discrete samples at 1' increments down to 5' bgs, see Fig. 5	The purpose of this sample collection effort will be to collect data to evaluate the long-term fate of the metal in tailings and the chemical stability of the tailings.
Site	Soils	List 2	Evaluate tailings south of diversion ditch, determine extent of tailings and impacts to diversion ditch and groundwater, see Fig 5.	Provide a definitive model of the extent of the tailings located south of the diversion ditch and to define study boundaries.

List 1 Analytes: pH, As, Pb,

List 2 Analytes: pH, Ag, As,Cd,Cu, Fe, Hg, Pb, Sb, Se, Zn,CEC

List 3 Analytes: TSS, TDS, pH, hardness, Alk, Ag,Ag-d,As,As-d,Cd,Cd-d,Fe,Fe-d,Hg,Hg-d,Pb,Pb-d,Sb,Sb-d,Se,Se-d,Zn,Zn-d,Ca,K,Mg,Na,Cl,SO4,CO3,HCO3,NO2,NO3, CA/AN Bal.

Appendix A
Site Heath and Safety Policy

United Park Health and Safety Policy
Richardson Flat Site
Park City, Utah

Site ID Number: UT980952840

Prepared for:

United Park City Mines Company
Park City, Utah

Prepared by:

Resource Management Consultants, Inc
Midvale, Utah

January 2001

Figures
Emergency Route to Hospital

Appendix
Emergency Contact Phone Numbers

1.0 INTRODUCTION

This Health and Safety Policy (HASP) is intended to protect all employees, general contractors, subcontractors, and/or visitors conducting or observing any activities under the direction of United Park City Mines Company (United Park). This HASP is intended to apply to activities taking place at the Richardson Flat Tailings Site (hereafter referred to as the Site), and covers both investigation and construction. The policy is intended to minimize potential exposures and/or accidents that may occur, and details the actions to be taken during an emergency. The HASP will establish required procedures intended to minimize exposures of United Park personnel, contractors, visitors and the surrounding community. Guidelines contained herein that are appropriate to the activities taking place at the Site will be observed at all times.

All personnel will be required to understand and observe the provisions of this plan. Any tasks associated with investigation or remediation activities on the Site must be performed in accordance with this policy, designed to ensure that employees are adequately protected from any potential chemical and/or physical hazards present at the Site. To help ensure safety compliance, all field participants and observers must read this plan and sign a certification stating that they agree to comply with the conditions of the policy. All activities conducted will be in accordance with 29 CFR part 1910, *OSHA standards for general industry.*

1.1 Site Description

The Site covers approximately 700 acres in a small valley in Summit County, Utah, located one and one-half miles northeast of Park City, Utah. The Site includes a tailings impoundment covering approximately 160 acres in the northwest corner of the Property and lies within the NW quarter of Section 1 and NE quarter of Section 2, Township 2 South, Range 4 East, Summit County, Utah.

United Park personnel will be investigating the soil and water in and around the tailings impoundment. During the course of this investigation, there exists a potential for personnel to have limited contact with tailings contained on the Site. The mill tailings present at the Site consist mostly of sand-sized particles of carbonate rock with some minerals containing silver, lead, zinc and other metals. Currently, tailings at the Site are completely covered with a layer of clean fill.

1.2 Site Activities

This HASP is intended to address the risks associated with sampling and construction activities, which will take place at the Site. During the course of investigation by United Park, personnel will be required to visit the Site in order to collect soil and water samples for chemical analysis. Personnel will also visit the Site to survey and perform other miscellaneous tasks. The procedures contained in this HASP are intended to protect those personnel from potential hazards while carrying out their duties, and provide them with information necessary in the event of an emergency.

It is anticipated that investigations by United Park may also involve limited construction activities, including excavation and/or removal of soils. The HASP has therefore included procedures for equipment and personnel involved in construction activities at the Site.

2.0 PROJECT MANAGEMENT

Efficient implementation of this policy requires that the roles, responsibilities and scope of authority for key personnel be identified. United Park shall identify individuals responsible the following positions:

2.1 Project Manager

The Project Manager is responsible for implementation of the work plan and compliance with the HASP.

2.2 Health and Safety Manager

The Health and Safety Manager will have a thorough working knowledge of state and federal occupational safety and health regulations in addition to thorough knowledge and understanding of this policy. The Health and Safety Manager will have the authority to temporarily suspend site operations in order to ensure site safety and resume normal operations once the appropriate measures have been taken. The Health and Safety Manager will report directly to the Project Manager.

2.3 Site Manager

The Site Manager will be present during the majority of site activities and will be responsible for general site activities, supervision and enforcement of this HASP. The Site Manager will report directly to the Health and Safety Manager.

2.4 Supervisor

The Supervisor(s) will be present during all on-site activities and will report directly to the Site Manager.

Note: The aforementioned personnel may be increased, or personnel may share responsibilities dependent upon specific site conditions.

3.0 TRAINING

3.1 Off-Site Training

All full-time, part-time and short-duration workers must hold current certification of the Occupational Safety and Health Administration (OSHA) Hazardous Waste Operations and Emergency Response (HAZWOPER) 40-hour training. Visitors must hold current certification of OSHA/HAZWOPER 40-hour training and shall be escorted at all times by an experienced and trained Site Manager.

3.2 On-Site Training

An informational training program implemented by United Park will cover on-site training.

3.3 Weekly Health and Safety Meetings - Construction

During any construction or excavation activities, the site Health and Safety Manager will conduct mandatory weekly safety meetings for all site personnel. The meetings will provide time for refresher courses, and new site conditions will be examined as they are encountered.

3.4 CPR and First Aid Training Requirements - Construction

During any construction or excavation activities, a minimum of one worker per work crew or shift shall have a current certificate of training in first aid and CPR. These workers must have appropriate training and medical surveillance to enter the Site.

4.0 MEDICAL SURVEILLANCE

4.1 Medical Surveillance - General

Medical surveillance will be obtained if personnel:

- Receive, or may have received, a possible overexposure to on-site contaminants;
- Received an injury requiring hospital or medical attention;
- Experience an unexplained or serious illness.

4.2 Medical Surveillance - Construction

A yearly physical examination shall be provided for field personnel involved with excavation of any tailings material in excess of 500 yd^3. The examination shall emphasize skin, renal, hepatic, immunological, neurological, and hematological systems, and shall include tests for liver and kidney function. If construction personnel are exposed to tailings materials on-site for thirty (30) days or more, they will participate in a medical examination program according to OSHA's lead (29 CFR 1926.65) standard.

5.0 HEALTH AND SAFETY PROTECTION

5.1 Substance Hazards

Lead, arsenic and cadmium are known to exist on the Site, and personnel should be briefed on exposure and health hazards. It is not anticipated that exposures to these substances will exceed OSHA's Personal Exposure Limit (PEL). The following table lists the primary hazards associated with significant exposure to each substance.

Lead	Toxic on inhalation and ingestion.
Arsenic	Toxic on inhalation and ingestion; skin irritant; known human carcinogen.
Cadmium	Toxic on inhalation and ingestion; suspected human carcinogen through inhalation only.

5.2 Safety Hazards

Investigation activities may expose field personnel to potential physical hazards including, but not limited to:

- Holes and ditches
- Uneven terrain
- Slippery surfaces
- Electrical equipment
- Mobile equipment
- Overhead hazards
- Underground hazards

5.3 Personal Protection Equipment - Construction

The minimum level of protection used during any construction activities is level D, requiring the following items:

- Hardhat;
- Steel-toed boots;
- Safety glasses;
- Cotton coveralls;
- Work gloves;
- Sampling gloves;
- Hearing protection, when needed.

5.4 Personal Air Monitoring – Construction

During construction activities involving contact of tailings material, personal air monitoring will be conducted to verify and document exposures to lead, arsenic, and cadmium on this project do not exceed the OSHA PEL's. Personal air monitoring will only occur when tailings are contacted in excess of 500 yd^3. If monitoring reveals exposures above an OSHA PEL, then field personnel will be upgraded to level C protection.

5.4.1 Work Practices to Reduce Employee Exposure - Construction

While performing any construction/excavation activities, work practices shall be instituted to ensure worker exposure remains below the applicable PEL. Work practices will include wetting down excavation-sites as needed throughout any excavation operation. The site safety officer will be responsible to monitor the dust control operations when needed.

5.5 Exposure to Elements

5.5.1 Heat Stress

The potential for heat stress depends on the type of protective gear being worn, the ambient temperature, and the amount of activity. Personnel will report any cases of dizziness, excessive sweating, increased respiratory rate, or pulse and are to leave the work area immediately if these conditions are noted. Work cycle lengths will be based initially on subjective input from personnel, and will be reduced and a monitoring program will be initiated if the above are noted. Work cycles will also be reduced if a pulse rate of greater than 110 is noticed during rest. Personnel with elevated rates will not return to work until the pulse has lowered to their resting rate.

Workers exhibiting signs of heat stress will have their oral temperature measured at the beginning of a rest period before liquid intake. If oral temperature exceeds 99.6° F, the next work cycle will be shortened by one-third without changing the rest period. If the oral temperature still exceeds 99.6° F at the beginning of the next rest period, the next work cycle will be shortened by another one-third. If the oral temperature exceeds 100.6° F, the worker will not be allowed to wear semi-permeable or impermeable clothing. If an employee is overcome with heatstroke or becomes unconscious, the 9-1-1 service will be called. First-aid procedures will be used for heat related conditions, as necessary. Some of the signs and symptoms of heat stress are as follows:

5.5.1.1 Heat Rash

Symptoms of Heat Rash include:

- Profuse tiny raised vesicles on the skin
- Pricking sensations during heat exposure

5.5.1.2 Heat Cramps

Symptoms of Heat Cramps include:

- Painful spasms of muscles used during work
- Onset during or after work hours

5.5.1.3 Heat Exhaustion

Symptoms of Heat Exhaustion include:

- Fatigue
- Nausea
- Headache
- Giddiness
- Clammy and moist skin
- Pale complexion
- Upon standing, fainting possible, with rapid, thready pulse and low blood pressure

5.5.1.4 Heatstroke

Symptoms of Heatstroke include:

- Hot dry skin usually red, mottled or cyanotic
- Confusion, loss of consciousness, and convulsions

Note: Heat stroke may be fatal if treatment is delayed

5.5.2 Cold Stress

During on-site activities, workers may be exposed to cold temperatures. Exposure to cold temperatures increases the likelihood and potential for disorders or conditions that could result in injury or illness. Factors leading to hypothermia and frostbite include ambient temperature, wind velocity, exposure time and insufficient cold-weather protective gear. Signs of excess cold exposure include uncontrollable fits of shivering, slurred speech, memory lapses, immobile hands, stumbling, drowsiness, and exhaustion. Treatment for these symptoms are to get the victim out of the wind and cold, remove wet clothing, supply a warm drink, and keep victim warm with blankets or clothing.

5.5.2.1 Hypothermia

The first symptoms of this condition are uncontrollable shivering and the sensation of cold, irregular heart beat, weakened pulse, and change in blood pressure. Severe shaking of rigid muscles may be caused by a burst of body energy and changes in the body's chemistry. Vague or slow slurred speech, memory lapses, incoherence, and drowsiness are some of the additional symptoms. Symptoms noticed before complete collapse are cool skin, slow and irregular breathing, low blood pressure, apparent exhaustion, and fatigue even after rest. As the core body temperature drops, the victim may become listless and confused, and may make little or no attempt to keep warm. Pain in the extremities can be the first warning of dangerous exposure to cold. If the body core temperature drops to about 85° F, a significant and dangerous drop in the blood pressure, pulse rate, and respiration can occur. In extreme cases, death will occur.

5.5.2.2 Frostbite

Frostbite can occur, in absence of hypothermia, when the extremities do not receive sufficient heat from central body stores. This can occur because of inadequate circulation and/or insulation. Frostbite occurs when there is freezing of fluids around the cells of the body tissues due to extremely low temperatures. Damage may result, including loss of tissue around the areas of the nose, cheeks, ears, fingers, and toes. This damage can be serious enough to require amputation or result in permanent loss of movement. The potential for both heat and cold related disorders or conditions can occur in many common situations. Cold early morning temperatures can give way to warm daily temperatures, resulting in heavy perspiration within protective clothing. As temperatures cool again in the evening, the potential for cold related disorders or conditions can occur. Managers should be aware of the potential for this occurrence and should monitor workers accordingly.

5.5.3 Wind Exposure

Extreme low temperatures may not be the only element necessary to create the potential for cold exposure disorders or conditions; strong wind accompanied by cold temperatures can lead to these types of disorders or conditions. The windchill factor is the cooling effect of any combination of temperature and wind velocity or air movement. The windchill factor should be considered when planning for exposure to low temperatures and wind.

5.5.4 Logs and Reports

United Park will maintain all records required by OSHA, Worker's Compensation Insurance and similar regulations. This will include the maintenance of accident logs, the OSHA annual summary report and the posting of all prescribed notices.

6.0 SITE CONTROL

Site control will be implemented for both investigation and construction activities as needed.

6.1 Investigation

6.1.1 Work Zone

All investigatory activities, including but not limited to surveying and sampling, at the Site will take place within the work zone; this includes the tailings impoundment and the area immediately surrounding it, currently demarcated with fencing. This area will be restricted to appropriately trained personnel, and any non-approved personnel will immediately be escorted off-site.

6.1.2 Cleaning/Maintenance Area

At the entrance(s) of the work zone, an area will be provided for removal of gross contamination from both hand tools and personnel. United Park personnel and/or representatives will remove gross contamination from their boots and coveralls. Facilities will be provided for personnel to wash their hands and face as needed. At a minimum, facilities will include fresh water, soap, towels and waste receptacle.

6.2 Construction

6.2.1 Work Zone

All construction activities carried out at the Site will occur within the work zone, currently demarcated by fencing. This area poses a potential hazard and will therefore be restricted to trained workers with the appropriate personal protective equipment. Any excavation-sites will be demarcated by yellow barrier tape, if not backfilled prior to the end of each workday. An area that has been backfilled will be considered as lacking hazards, unless exposed utilities, etc. create a hazard. Such hazards will be demarcated with barrier tape.

6.2.2 Cleaning/Maintenance Area

At the entrance(s) of the work zone, an area will be provided for removal of gross contamination from both equipment and personnel. United Park personnel and/or representatives having contact with any tailings material will be required to remove gross contamination from their vehicles, equipment, boots and coveralls prior to leaving the Site. At a minimum, facilities will be provided including pressurized water, scrub tools for vehicles and equipment, and fresh water, soap, towels and waste receptacle.

6.3 General Maintenance

General cleaning maintenance is key in helping to maintain acceptable exposure levels for lead, arsenic, and cadmium. General cleaning/maintenance will be required for all equipment and facilities used by on-site as well as off-site personnel. This will include, but is not limited to a change and/or shower facility, office areas, and lunch facilities.

6.4 Equipment Safety

All mobile equipment with limited visibility to the rear shall be equipped with audible back-up alarms. If mobile equipment is operated at night, it shall be equipped with head lights and taillights. All equipment will be maintained in good condition. When the operator leaves the cab of mobile equipment, emergency brakes shall be set and any hydraulics released. If a truck is parked on an incline, it shall have the tires chocked.

When refueling, engines on all equipment shall be shut off. All mobile equipment will be supplied with a fire extinguisher with a rating of not less than 5-B rating, and the service truck will be supplied with a fire extinguisher with a rating of not less than 20-B rating.

6.5 Electrical Safety

Electrical power tools will continuously be inspected for damage. Electric tools with frayed cords or broken housings will be tagged and taken out of service.

If tools are used in wet conditions, they must be listed or labeled as double insulated. All extension cords will be of the three-wire ground type and be connected to a ground fault circuit interrupter (GFCI). If extension cords are not plugged into a permanently mounted GFCI, then the extension cord must be supplied with a waterproof GFCI. Extension cords that are spliced, worn, or frayed are not to be used. Extension cords must have the manufacturers rating on the cord and it must be legible; if it is not legible the cord must be taken out of service.

6.6 Miscellaneous Site Safety Rules

Miscellaneous Site Safety Rules include the following:

- Smoking, eating, chewing, applying cosmetics, etc. is not allowed on-site.
- A minimum of two personnel shall be on-site at all times.
- No horseplay is permitted at any time
- Vehicles used to transport personnel shall have seats firmly secured and adequate for the number of persons to be carried.
- Seat belts and anchors meeting the requirements of 49 CFR part 571 (department of transportation, federal motor vehicle safety standards) shall be installed in all motor vehicles.

7.0 DECONTAMINATION

7.1 Field Personnel

Decontamination procedures for field personnel shall be:

- Gross contamination removal from clothing and boots prior to leaving the Site.
- Wash hands and face at facility provided
- Containment of dirty coveralls.
- Launder coveralls at commercial laundry.

7.2 Equipment

The decontamination procedures for equipment contacting tailings shall be:

- Clean vehicles (inside and out) as needed prior to leaving the Site.
- Construction equipment, backhoes, loaders, dump trucks, hand tools, trailers hoses, etc contacting any tailings material will be cleaned of gross excavated soil material before leaving the Site and pressure washed upon culmination of scheduled work.
- Sampling equipment and hand tools not contacting tailings material will be cleaned of gross contamination prior to leaving the Site.

8.0 EMERGENCY RESPONSE

Accidents or potentially hazardous conditions will be handled in a manner to minimize the health risk to personnel. Accidents and hazardous conditions will be reported to the site safety officer. Prior to the start-up of this project, methods of communication will be established in order to summon emergency services in a timely manner. Supervisory personnel and the Site Safety Officer will be trained in first aid/CPR.

8.1 Emergency Route to Hospital

The emergency route to local medical facilities is shown in Figure 1 and emergency contacts with phone numbers are listed in Appendix A

8.2 Incident Command System

The Incident Command System used on this project will utilize different senior response officials depending on the nature of the incident. Front line supervisors are the initial "Senior Official" until the Project Manager or the Health and Safety Manager arrives. When emergency officials arrive, they shall become the "Senior Official".

8.3 Response Procedures

All United Park personnel will be trained in general procedures in the event of an emergency. Prior to beginning any work, personnel will be required to review the emergency procedures of this plan and ensure that all necessary equipment is ready for use in the event of an emergency. Visitors to the Site should also be briefed on these procedures.

Common forms of emergency include, but are not limited to fires, explosions, spills, sudden changes in weather, and personal illness or injury. The following emergency response procedures have been developed to help ensure a timely and efficient response to emergency situations that may arise.

8.3.1 Major and Minor Personal Injury

If field personnel are injured, the incident scene will be evaluated for immediate hazards and actions taken to eliminate those hazards. Once the incident scene is safe, the "Senior Official" will make an evaluation of the injured person. Seriously injured personnel should not be moved unless their life is in immediate danger and until a person trained in first-aid and CPR has made an assessment.

If the victim is conscious, first-aid may only be administered with the injured person's permission. If the victim is unconscious or unable to respond, then no permission is required to provide standard first aid. If no outside emergency services are needed, the

"Senior Official" will arrange for the injured person to be transported to the predetermined medical facility.

If it is determined that emergency medical services are needed, the emergency services listed in Appendix A will be contacted as soon as possible. Calling for help is often the most important action to be taken. If you are the only person with the injured employee and urgent care is needed, provide initial critical care and then contact the outside emergency services. Return to care for the victim as soon as possible.

First-aid or other appropriate actions can be administered by the initial "Senior Official" or by the victim. For injuries requiring medical treatment such as a laceration requiring stitches or a sprained ankle, the "Senior Official" shall arrange transportation to the emergency facility as noted in Figure 1. For major injuries, the "Senior Official" may administer first-aid. The "Senior Official" rendering assistance will not place themselves in a situation of unacceptable risk.

8.3.2 Fire or Explosion

In the event of a fire or explosion, the local fire department will be notified immediately. The "Senior Official" will notify the emergency services and inform them of the location, nature and identification of any hazardous materials on-site.

During the beginning stages, the closest person to the incident will take measures to extinguish the fire using a fire extinguisher or water hose. If the fire progresses beyond the beginning stages, the "Senior Official " will evacuate workers and any other occupants on the property from the immediate area and allow local fire officials to attend to the situation.

8.4 Notification and Documentation Procedures

As soon as practical following an accident/incident, the accident/incident will be documented using the appropriate report forms and the site safety officer will be notified.

8.5 On-Site Emergency Equipment

The following emergency equipment will be maintained at all work sites.

- Cellular Telephone;
- First-aid kit;
- Fire extinguisher; and
- Emergency eye wash solution.

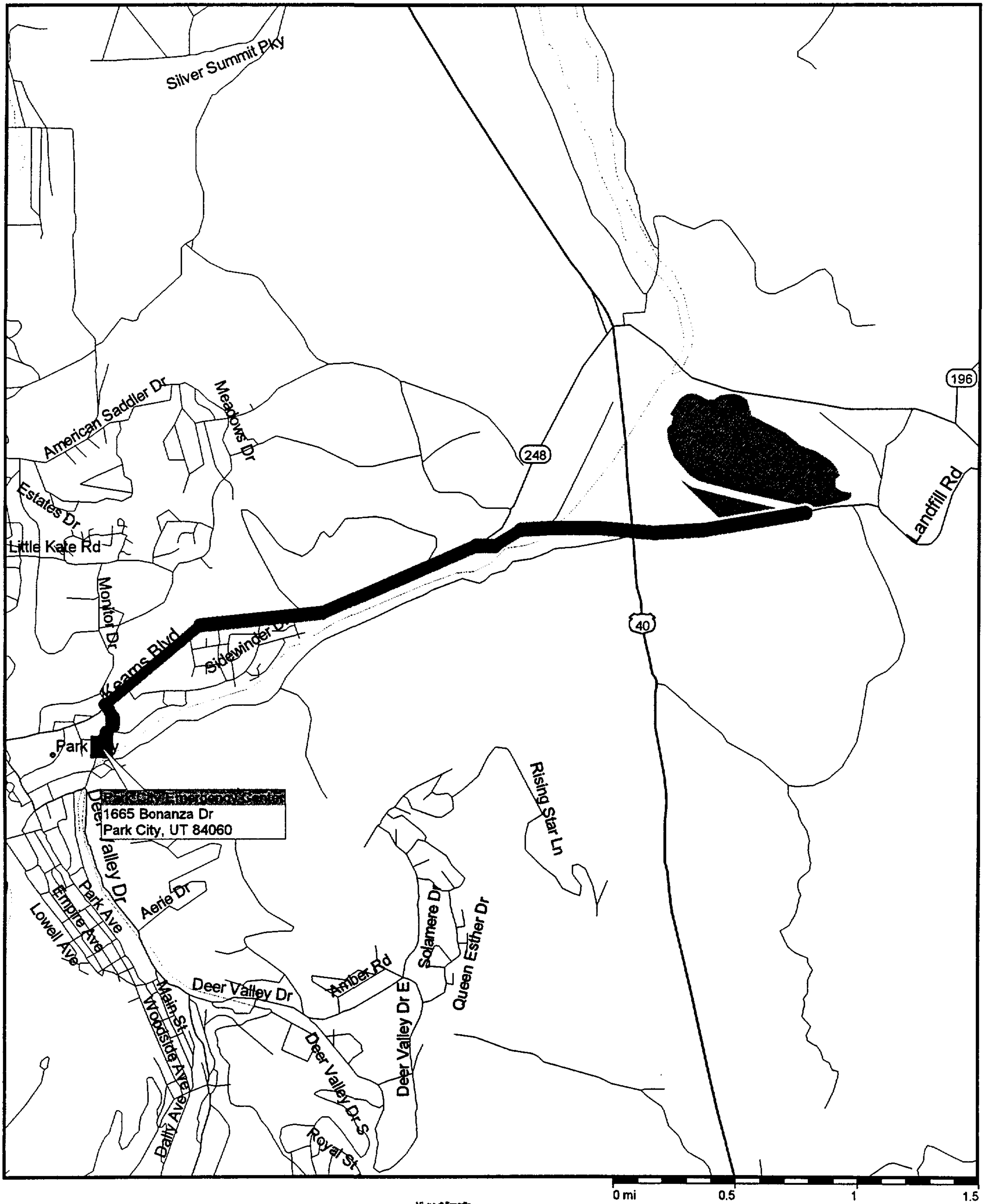
APPENDICES

Appendix A – Emergency Contact Phone Numbers

Organization	Telephone
Any Emergency	**911**
Ambulance:	911
Local Police:	435-645-5500
Fire:	911
State Police:	801-576-8606
Hospital (Primary)	435-649-7640
Hospital (Secondary)	435-655-0055
Poison Control Center:	801-581-2151
Regional EPA:	800-227-8917
EPA Emergency Response Team:	800-227-8914
National Response Center:	800-424-8802
Center for Disease Control:	404-639-3311
Chemtrec:	800-262-8200
Spill Center:	978-897-6461
Site Emergency Operations Center:	801-355-2350
DOE Emergency Operations Center (National Center):	202-586-5000

FIGURES

Figure 1 - UPCM Richardson Flat Emergency Route



Appendix B
Standard Operating Procedures

RMC SOP 1
STANDARD PROCEDURES FOR COLLECTION OF SURFACE WATER SAMPLES AND GENERAL WATER SAMPLE HANDLING

1.0 Purpose

This SOP describes the procedures that will be used for collection of surface water samples. The procedures will ensure that samples are collected and handled properly and that appropriate documentation is completed. The procedures outlined in this SOP detail the procedures used for the treatment/handling of water samples collected from other sources (e.g. monitoring wells).

2.0 Sampling Equipment

- Field data sheets / Field notebook / Chain of Custody Forms (COC) – Documentation of sample activities, field notes and sample custody.
- Sample containers – Containers provided by laboratory for the collection, storage and transportation of samples.
- Direct reading instruments – field instruments to measure pH, conductivity and temperature.
- Disposable sampling gloves – to prevent exposure to water and the prevention of cross-contamination.
- Custody seals – seals to be placed on sample containers to maintain sample integrity.
- 0.45 um filter apparatus with inert filters – for filtering samples in preparation for the analysis of dissolved metals.
- Nitric acid (HNO_3, supplied by the analytical laboratory) – for sample preservation.
- Water velocity meter and tape measure – to measure stream flow (where applicable).
- Distilled water – for rinsing direct reading instruments.
- Custody seals – seals to be placed on sample containers to maintain sample integrity.

3.0 Procedure

Sample bottles will remain sealed until the water sample is collected. At that time, the bottle lid will be removed and placed, top down, in an appropriate place. The sample bottle will be placed under the flow of water. The container will be rinsed three times prior to sample collection. If wading is required for sample collection, the sample must be collected upstream of wading personnel to avoid the sampling of suspended sediments. After rinsing, the sample container will be completely filled; any overflow of the sample container will be kept to a minimum. Sediment disturbance shall be kept to an absolute minimum. The sample cap will then be replaced on the sample bottle. All surface water samples will be collected in accordance with containers, volumes, preservatives, temperatures and holding times as outlined in Table 2 of the Sampling and Analysis Plan.

4.0 Dissolved Metals Analysis

Surface water samples collected for analysis of Dissolved (D) Metals will be a minimum volume of 500 ml, collected in a poly or glass container. The samples will be field filtered. The field filtering methodology will include the following steps:

1: Sample shall be collected in a 1000 ml bottle.

2: Sample is poured into the top of the disposable plastic filter.

3: Vacuum pump is attached to the filter and pumped.

4: When the bottom compartment of the filter is full, the water is to be transferred into a 500 ml sample container which shall be rinsed three times, the sample will be preserved with 2 ml of nitric acid (HNO_3), sufficient to bring the sample to pH <2.

5: The pH level in samples will be verified using pH paper before bottles are sealed.

5.0 Total Metals Analysis

Surface water samples collected for analysis of Total (T) Metals will be a minimum volume of 500 ml, collected in a poly or glass container, and preserved with 2 ml of nitric acid (HNO_3), sufficient to bring the sample to pH <2. The pH level in samples will be verified using pH paper before bottles are sealed.

6.0 Cations/Anions and Total Suspended Solids

Cations/Anions and Total Suspended Solids samples shall be collected in accordance with the methodologies outlined in the Procedure section of this SOP. Samples will not be preserved.

7.0 Field Parameter Collection – pH, Temperature and Conductivity

Temperature, pH and Conductivity measurements will be collected in the field at the time of sampling. All Direct reading field instruments will be calibrated prior to daily use according to the manufacturers specification manual/instructions provided with each instrument. Field data will be collected according to the manufacturers specification manual/instructions for each instrument. Water samples shall be placed into a clean container such as a sample bottle or 1 gallon bucket. The instrument probes will be placed into the water sample. Field data collected in this procedure will be recorded in the field notebook and Field data sheet for each sample.

7.0 Stream Flow Measurement

Stream flow volumes shall be measured during surface water sampling activities. To minimize sediment disturbance during sampling, the stream flow measurements should be conducted either downstream from the sampling point or after the completion of sample collection. RMC uses an electronic flow meter. The procedure for measuring stream flows is as follows:

1: Measure the width of the stream and divide the width into 0.5 foot increments.

2: At the midpoint of each 0.5 foot increment, record the total depth of the stream. The water velocity shall be measured at 0.6 of the total height of the water (e.g. if the water is one foot deep the velocity is measured at a depth of 0.4 foot from the surface or 0.6 feet from the streambed).

3: Turn the electronic stream meter gauge on. Set the meter to record the average velocity. Insert the stream flow gauge into the water at the midpoint of each segment with the arrow pointing in the direction of flow. Measure the velocity for approximately one minute and record the average.

4: Calculate the stream flow by calculating the area of each 0.5 foot wide segment by multiplying the width times depth. To obtain the flow volume for each 0.5 wide segment multiply the area of the segment by the average flow velocity for the segment. To obtain the total stream flow, add the total stream flow for each segment. An Excel spreadsheet is typically used for the calculations.

Calculations:

Segment flow volume = depth of 0.5 foot segment x width x flow velocity (feet/sec.) = cubic feet/ second
Total flow volume = sum of segment flow volumes.

8.0 Labeling

Each sample will be labeled with the following information:

- Sample identification;

- Project number/name;
- Analyses requested;
- Preservatives (if required);
- Date/time collected; and
- Samplers initials.

9.0 Documentation

Field activities shall be recorded in a hard bound field notebook and field data sheet. Field notes shall include all pertinent information including but not limited to:

- Date and time samples were collected;
- Physical description of sample area;
- Identification of samples collected;
- Total number of samples collected;
- Total number of samples collected from each sample location;
- Physical description of samples;
- Preservatives used for samples;
- Sample container types;
- Filtered vs. Unfiltered samples;
- Analysis to be performed;
- Weather conditions;
- Hand sketches of subject area(s); and
- Description and date of any photograph(s) taken.

Sample handling and Chain of Custody documentation shall be in accordance with RMC SOP 5 found in this document.

10.0 Demobilization

After Decontamination, sample equipment will be stored in the appropriate, clean containers. Any equipment that suffers damage or excessive wear while conducting sampling will be labeled and reported to the equipment manager for the necessary maintenance, repair and/or replacement.

SOP 2a

STANDARD PROCEDURES FOR COLLECTION OF SURFACE SOIL SAMPLES

1.0 Purpose

This SOP describes the procedures that will be used for sampling surface soils from ground surface to a maximum depth of 18 inches below surface. Samples will be collected with a Decontamination shovel or hand auger/probe. Specific soil sampling locations will be determined from the project work plan.

2.0 Sampling Equipment

- Hand Auger/Probe and/or Shovels – For the collection of soil samples below the ground surface.
- Field data sheets / Field notebook / Chain of Custody (COC) - Documentation of sample activities, field notes and sample custody.
- Sample containers - Containers provided by laboratory for the collection, storage and transportation of samples.
- Stainless steel sample spoons – For the collection of surface soil samples and composite sample mixing.
- Stainless steel bowl or sealable plastic bags for mixing composite samples.
- Sample location staking – For the marking and identification of sample locations. Staking should be easily visible for surveying.
- Disposable sampling gloves – to prevent exposure to soils and the prevention of cross-contamination.
- Custody seals – seals to be placed on sample containers to maintain sample integrity.

3.0 Decontamination Equipment

- 5 gallon buckets – For washing and the collection of rinsate.
- Alconox - Soap
- Scrub brushes – For cleaning sampling equipment.
- Distilled water – For final equipment rinse.
- Culinary tap water – for equipment rinse.
- Garbage bags – for clean equipment storage.

4.0 Procedure

All samples shall be collected using Decontaminated equipment. Decontamination procedures are detailed in RMC SOP 6.

4.1 Discrete Samples

If significant vegetation, rocks, or debris prevent collecting the surface samples then the upper 2-3 inches of soil will be scraped away from the sample location with a shovel or stainless steel spoon. The underlying soil will then be collected and placed into sample containers with a stainless steel spoon or gloved hand. Composite samples will be homogenized as described below. Coarse grained soils, gravel and rock fragments will be removed wherever possible.

4.2 Composite Samples

Composite samples will be collected (as described above) by placing sub samples into a stainless steel mixing bowl or a clean plastic bag, or by hand with new, clean sampling gloves. The sample will be homogenized with a stainless steel spoon or gloved hand. The homogenized soil will be packaged in a laboratory-supplied sample container, labeled and placed in a cooler to maintain temperature.

4.3 Sample Preparation

Soil Samples collected for human health risk assessment shall be sieved to <250 microns. The <250 micron fraction is then analyzed for metals. For ecological screening/risk assessment purposes, sieving should not occur. Sieving shall be performed by the laboratory.

5.0 Labeling

Each soil sample will be labeled with the following information:

- Sample identification;
- Project number/name;
- Analyses requested;
- Date/time collected; and
- Samplers initials.

6.0 Documentation

Field activities shall be recorded in a hard bound field notebook and field data sheet. Field notes shall include all pertinent information including but not limited to:

- Date and time samples were collected;
- Physical description of sample area;
- Identification of samples collected;
- Total number of samples collected per sampling event;
- Total number of samples collected from each sample location;
- Physical description of samples;
- Preservatives used for samples;
- Sample container types;
- Filtered vs. Unfiltered samples (water);
- Analysis to be performed;
- Weather conditions;
- Hand sketches of subject area(s); and
- Description and date of any photograph(s) taken.

Sample handling and Chain of Custody documentation shall be in accordance with RMC SOP 5 found in this document.

7.0 Demobilization

After Decontamination, sample equipment will be stored in the appropriate, clean containers. Any equipment that suffers damage or excessive wear while conducting sampling will be labeled and reported to the equipment manager for the necessary maintenance, repair and/or replacement.

SOP 2b

HAND AUGER SOIL SAMPLING

1.0 Purpose

Hand auger equipment will be used for collecting shallow soil samples to approximately 5 feet below ground surface. This SOP describes the procedures for collecting soil samples using hand auger equipment.

2.0 Equipment

- Hand augers
    - Clay auger barrel – for the collection of clay rich soils.
    - Sand auger barrel – for the collection of sandy soils.
    - Extension rods – For connecting the sample barrel to the handle
    - T handle- for turning the auger assembly.
- Two crescent wrenches – For attaching/breaking down the hand auger.
- Tape measure – for the measurement of sample depths/intervals.
- Field data sheets / Field notebook / Chain of Custody (COC) - Documentation of sample activities, field notes and sample custody.
- Sample containers – for sample storage and transportation.
- Disposable sampling gloves – to prevent exposure to soils and the prevention of cross-contamination.
- Surface patching supplies, if necessary (asphalt patch/post mix)
- Stainless steel bowl or sealable plastic bags for mixing composite samples.
- Custody seals – seals to be placed on sample containers to maintain sample integrity.

3.0 Decontamination Equipment

- 5 gallon buckets – For washing and the collection of rinsate.
- Alconox - Soap
- Scrub brushes – For cleaning sampling equipment.
- Distilled water – For final equipment rinse.
- Culinary tap water – for equipment rinse.
- Garbage bags – for clean equipment storage.

4.0 Preliminaries

All boring locations will be determined using the project specific Work Plan. Arrangements will be made for the location of underground utilities using Blue Stakes. A private locating service will be used for utilities that are not covered by Blue Stakes.

5.0 Procedures

The borehole will be advanced using the clay bucket for fine-grained soils and the sand bucket for coarse-grained soils. Each auger bucket of soil will be described and recorded on the soil boring log. Soil samples selected for laboratory analysis will be placed in an appropriate container.

6.0 Labeling

Each soil sample will be labeled with the following information:

- Sample identification;
- Project number/name;
- Analyses requested;

- Date/time collected; and
- Samplers initials.

7.0 Documentation

Field activities shall be recorded in a hard bound field notebook and field data sheet. Field notes shall include all pertinent information including but not limited to:

- Date and time samples were collected;
- Physical description of sample area;
- Identification of samples collected;
- Total number of samples collected per sampling event;
- Total number of samples collected from each sample location;
- Physical description of samples;
- Preservatives used for samples;
- Sample container types;
- Filtered vs. Unfiltered samples (water);
- Analysis to be performed;
- Weather conditions;
- Hand sketches of subject area(s); and
- Description and date of any photograph(s) taken.

Sample handling and Chain of Custody documentation shall be in accordance with RMC SOP 5 found in this document.

8.0 Decontamination

All samples shall be collected using Decontaminated equipment. Decontamination procedures are detailed in RMC SOP 6.

9.0 Demobilization

After Decontamination, sample equipment will be stored in the appropriate storage containers. If any equipment is damaged while conducting soil sampling, the damaged equipment will be labeled and reported to the equipment manager for maintenance or replacement.

SOP 2c

GEOPROBE SAMPLING

1.0 Purpose

Geoprobe™ sampling equipment will be used to advance shallow soil borings (30 feet or less) to collect soil and groundwater samples and for sites where access restrictions prevent mobilization of a drill rig. Standard operating procedures for geoprobe soil and groundwater sampling are described below.

2.0 Preliminaries

Geoprobe sample locations will be marked or staked in the field and coordinated with the RMC project manager and, if necessary, the client project manager. Blue Stakes utility clearance will be requested for each boring location prior to geoprobe sampling. Borings will be located at least two feet from marked underground utilities.

All sampling equipment will be decontaminated prior to mobilizing to the site. This equipment includes all geoprobe rods, geoprobe samplers, and stainless steel bowls and spoons.

3.0 Geoprobe Equipment and Procedures

Soil borings will be advanced and sampled using a geoprobe hydraulic hammer mounted to a truck, van, four-wheeler, or small tractor. Each borehole will be started by hydraulically hammering a 3 foot length of 1 inch outside diameter steel drill rod with a stainless steel sample collection tube into the ground. Each sample tube shall be Decontaminated prior to use. The borehole will be advanced in 3 foot increments by adding 3 foot sections of flush threaded drill rod to the drill stem. No lubricants or additives will be used while advancing geoprobe borings.

4.0 Soil Sampling Equipment

The following equipment will used to conduct soil sampling:

- Field data sheets / Field notebook / Chain of Custody (COC) - Documentation of sample activities, field notes and sample custody.
- Geoprobe core sampler (supplied by the geoprobe contractor).
- New sample liners (supplied by the geoprobe contractor).
- New sample liner end caps (supplied by the geoprobe contractor).
- Disposable sampling gloves – to prevent exposure to soil and water as well as the prevention of cross-contamination.
- Sealable plastic bags – for sample storage.
- Laboratory supplied glass soil sample jars and labels (optional).
- Razor blade knife – for splitting open sample tubes.
- Stainless steel bowl and spoon – for mixing composite samples.
- Custody seals – seals to be placed on sample containers to maintain sample integrity.

5.0 Decontamination Equipment

- 5 gallon buckets – For washing and the collection of rinsate.
- Alconox - Soap
- Scrub brushes – For cleaning sampling equipment.
- Distilled water – For final equipment rinse.
- Culinary tap water – for equipment rinse.
- Garbage bags – for clean equipment storage.

6.0 Decontamination

All samples shall be collected using Decontaminated equipment. Decontamination procedures are detailed in RMC SOP 6.

7.0 Soil Sampling Procedures

Samples will be collected as specified in the site specific sampling plan. At a minimum, soil samples will be collected at 5 foot intervals if lithologic information is needed. Each soil sample will be collected in a 2 foot long lined core sampler. The sampler will be attached to the drill rod, lowered to the sample interval and then hydraulically hammered two feet into the subsurface.

8.0 Groundwater Sampling Procedures

To facilitate the collection of groundwater samples at sites where the water table is penetrated, a temporary well point will be installed in the geoprobe borehole. After the water table has been encountered, the borehole will be advanced at least three more feet to ensure adequate sample volume. The well point may consist of either a three foot long stainless steel screen, attached to polyethylene tubing, or a length of 3/8inch polyethylene tubing with perforations in the bottom 3 feet. New tubing and well screens will be used for each well point. After approximately 15 minutes, a peristaltic pump will be attached to the tubing to obtain groundwater.

Groundwater samples shall be handled in accordance to the methods detailed for the handling/treatment of surface waters samples in RMC SOP1.

9.0 Sample Labeling

Each sample will be labeled with the following information:

- Sample identification;
- Project number/name;
- Analyses requested;
- Preservatives (water samples);
- Date/time collected; and
- Samplers initials.

10.0 Documentation

Field activities shall be recorded in a hard bound field notebook and field data sheets. Field notes shall include all pertinent information including but not limited to

- Date and time samples were collected;
- Physical description of sample area;
- Identification of samples collected;
- Total number of samples collected per sampling event;
- Total number of samples collected from each sample location;
- Physical description of samples;
- Preservatives used for samples;
- Sample container types;
- Filtered vs. Unfiltered samples (water);
- Analysis to be performed;
- Weather conditions;
- Hand sketches of subject area(s); and
- Description and date of any photograph(s) taken.

Sample handling and Chain of Custody documentation shall be in accordance with RMC SOP 5 found in this document.

11.0 Boring Abandonment

After all soil and groundwater samples have been collected, each soil boring will be backfilled with granular bentonite. Borings that were drilled through asphalt or concrete will be backfilled with granular bentonite to within six inches of the ground surface and the asphalt and concrete cores will be restored.

12.0 Demobilization

After the equipment has been rigged down and loaded, the site will be cleaned and restored as close to its original condition as possible. All sampling equipment will be Decontaminated prior to mobilizing to the next geoprobe sample location.

SOP 3a

HOLLOWSTEM AUGER DRILLING, SOIL SAMPLING AND MONITORING WELL INSTALLATION.

1.0 Purpose

Hollowstem auger drilling techniques will be used to advance intermediate depth borings of 100 feet or less. Standard operating procedures for hollowstem auger drilling and soil sampling are described below. Hollowstem auger drilling techniques will be used to install groundwater monitoring wells.

2.0 Preliminaries

Final soil boring locations will be marked or staked in the field and coordinated with the RMC project manager and, if necessary, the client project manager. Blue Stakes utility clearance will be requested for each drilling location to identify any subsurface utilities prior to drilling and sampling. If required, drilling and/or monitoring well permits will be requested by supplying the appropriate forms to the corresponding regulatory agency.

Boring locations will be located the following distances from overhead power lines:

Power Lines Nominal System (kV)	Minimum Required Clearance (ft)
0-50	10
51-100	12
101-200	15
201-300	20
301-500	25
501-750	35
751-1000	45

All drilling and sampling equipment will be Decontaminated with a steam cleaner prior to drilling. This equipment includes all drill pipe, auger flights, split-spoon samplers, brass sleeves, stainless steel bowls and spoons, tools, and non-packaged well screen and casing. Steam cleaning will be conducted after placing equipment, tools, and non-packaged screen and casing on racks or sawhorses to keep them off the ground. After steam cleaning is completed, the equipment will remain off the ground until it is used. Borings will be located according to the site specific work plan. No borings will be drilled within 5 feet of marked underground utility lines or within 10 feet of active overhead power lines. Boring locations will be adjusted, as necessary.

3.0 Drilling Equipment and Procedures

A truck mounted hollow stem auger drill rig will be used to drill borings of 100 feet or less. Augers will be sized to accommodate the well casing diameter, if a well is to be installed in the borehole. If flowing sands are encountered a center plug will be used to prevent liquefied sands from entering the inside of the auger string during monitoring well installation. No lubricants, circulating fluid, drilling muds, or other additives will be used during drilling. All drilling equipment will be supplied by the drilling contractor. The drilling contractor will supply a steam cleaner for drilling equipment decontamination.

4.0 Soil Sampling Equipment

The following equipment will be used to conduct soil sampling:

- Log forms / Field data sheets / Field notebook / Chain of Custody Forms (COC) – Documentation of sample activities, field notes and sample custody.
- Split-spoon samplers and sand catcher (supplied by the driller)
- New sample liners (supplied by the drilling contractor).

- New sample liner end caps (supplied by the drilling contractor).
- Disposable sampling gloves – to prevent exposure to soil and water as well as the prevention of cross-contamination.
- Sealable plastic bags – for sample storage.
- Laboratory supplied glass soil sample jars and labels (optional).
- Razor blade knife – for splitting open sample tubes.
- Stainless steel bowl and spoon – for mixing composite samples.
- Custody seals – seals to be placed on sample containers to maintain sample integrity.

5.0 Decontamination Equipment

- 5 gallon buckets – For washing and the collection of rinsate.
- Alconox - Soap
- Scrub brushes – For cleaning sampling equipment.
- Distilled water – For final equipment rinse.
- Culinary tap water – for equipment rinse.
- Garbage bags – for clean equipment storage.

6.0 Monitoring Well Equipment

Monitoring well equipment shall be supplied by the drilling contractor.

- Well screen - materials and intervals to be based on site conditions or specified in Workplans and/or Sample analysis plans. Screen size is to be determined based on specific site conditions.
- Well casing - materials and intervals to be specified in Workplans and/or Sample analysis plans.
- Sand and/or gravel pack – gradation to be determined based on site conditions.
- Betonite well seal – to provide annular well seal.
- Concrete – for well surface seal.
- Locking standpipe – to protect well assembly.
- Water proof locking well cap – to seal well and tamper prevention.
- Total depth probe – to measure the total depth of the open borehole and/or monitoring well annular pack.
- File – to cut a datum notch in the top of the well assembly.

7.0 Decontamination

All samples shall be collected using Decontaminated equipment. Decontamination procedures are detailed in RMC SOP 6.

8.0 Soil Sampling Procedures

Samples will be driven at intervals specified in the work plan. At a minimum, samples will be driven at 5 foot intervals, if lithologic data is needed. If loose, unconsolidated soils are encountered, a sand catcher will be placed at the end of the sampler so that unconsolidated soils are not lost as the sampler is retrieved from the borehole. The sampler will be advanced by blows from a 140-pound downhole hammer. The number of blows required to drive the sampler 6 inches will be recorded on the Soil Boring Log Form. The amount of recovery for each sample driven will be recorded on the soil boring log form.

Each site-specific sampling plan will identify the appropriate sample containers used to collect soil samples. If sample analytes do not include volatile or semi-volatile organic compounds, laboratory supplied glass jars or plastic bags may be used. Otherwise, samples should be submitted in brass or plastic (for inorganic analyses) sleeves.

Sleeves in the sampler will be separated using a stainless steel putty knife and the soil between the sleeves will be carefully cut so that the soil within the sleeve is flush at each end. Each sleeve will be sealed with an end cap. Each sleeve will be labeled with the sample identification and immediately placed in an iced cooler to maintain a temperature of 4°C. The remaining sample(s) will be used for soil classification. Samples may be removed from the sleeves for the mixing of composite samples.

9.0 Soil Boring Abandonment Procedures

Soil borings not used for well installations will be backfilled. If water is not encountered in the boring, the boring will be backfilled with drill cuttings. If water is encountered, the saturated portion of the boring will be backfilled with granular bentonite. Cuttings will be used to backfill the remainder of the boring. Borings that were drilled through asphalt or concrete will be patched to match existing conditions.

10.0 Storage and Disposal of Drill Cuttings

Drill cuttings and unused soil samples will disposed of on-site within the tailings impoundment.

11.0 Monitoring Well Installation

Monitoring well installation will occur in completed soil borings according to the procedure detailed below:

1: A soil boring shall be drilled to the anticipated total depth of the monitoring well.

2: The center tube and bit shall be removed from the auger assembly.

3: If flowing and/or heaving sands are encountered a center plug shall be used. If a center plug is required the auger assembly shall be removed from the hole and a new wood or plastic center plug will be placed at the base of the bottom section of auger. The auger will then be redrilled to the total depth of the borehole.

4: The monitoring well will assembly will be assembled and lowered into the center of the auger until the well is resting on the bottom of the borehole. The well casing will installed so that the top of the well assembly is approximately two to three feet above the ground surface. The well assembly will be handled using clean disposable gloves. If a center plug is used the well shall be lowered until the well assembly is resting on the center plug. The well will then be lifted slightly and dropped to release the center plug.

5: The sand/gravel pack will be poured into the annular space between the well assembly and the inner wall of the auger assembly. The sand/gravel pack shall be poured in three foot intervals. A Decontaminated total depth probe shall be used to measure the depth of the sand/gravel pack. Upon the completion of a three foot section of sand/gravel pack the auger shall be lifted two feet. This will allow the sand pack to fill the annular space between the walls of the borehole and the well assembly while keeping a portion of the sand/gravel pack inside of the auger assembly. This will prevent the collapse of the borehole and assuring the complete filling of the annular space between the borehole and monitoring well assembly. The sand/gravel pack installation shall continue until the sand/gravel pack is two feet above the top of the well screen.

6: Upon the completion of the sand/gravel pack an annular bentonite well seal shall be installed. The annular well seal will consist of bentonite pellets or chips. The bentonite seal shall be installed using the same procedure as outlined above for the sand/gravel pack. The bentonite well seal shall be installed to a depth of two feet below ground surface.

7: Upon the completion of the bentonite well seal, a cement surface seal and stand-pipe shall be installed. A steel stand-pipe shall be inserted into the bore hole to a depth of two feet. The stand-pipe shall contain a locking cover. The standpipe and cover assembly will be used to prevent unauthorized access to the well. The cement well seal shall be installed to ground surface in the annular space between the well casing and the inner wall of the stand-pipe. Cement will also be placed in the annular space between the outer wall of the stand-pipe and the wall of the borehole. The outer cement seal shall be configured to form an apron that slopes away from the well and hence aids in the prevention of surface water runoff flowing into the well.

8: Upon the completion of well construction a V-shaped notch shall be cut into the top of the well casing. This notch shall act as a permanent datum point for surveying. The stand-pipe shall be locked upon the completion of well construction activities.

9: The well shall be surveyed according to the datum requirements specified in individual Workplans and/or Sample Analysis Plans.

12.0 Labeling

Each sample will be labeled with the following information:

- Sample identification;
- Project number/name;
- Analyses requested;
- Date/time collected; and
- Samplers initials.

13.0 Documentation

Field activities shall be recorded in a hard bound field notebook and field data sheets. Field notes shall include all pertinent information including but not limited to:

- Date and time samples were collected;
- Physical description of sample area;
- Lithologic descriptions of soils encountered;
- Identification of samples collected;
- Total number of samples collected per sampling event;
- Total number of samples collected from each sample location;
- Physical description of samples;
- Preservatives used for samples;
- Sample container types;
- Analysis to be performed;
- Well construction details;
- Weather conditions;
- Hand sketches of subject area(s); and
- Description and date of any photograph(s) taken.

Sample handling and Chain of Custody documentation shall be in accordance with RMC SOP 5 found in this document.

14.0 Demobilization

After the site has been cleaned and restored as close to its original condition as possible. All drilling and sampling equipment will be Decontaminated with a steam cleaner prior to drilling and sampling the next soil boring.

SOP 3B
STANDARD PROCEDURES FOR MONITORING WELL DEVELOPMENT

1.0 Purpose

This SOP describes the procedures that will be used for developing monitoring wells after installation activities have been completed. Monitoring well installation procedures are detailed in RMC SOP 3a. Well development ensures that drilling fluids and/or sand pack materials are removed from the well prior to sampling and that water from the aquifer enters the well as designed.

2.0 Equipment

- Decontaminated pump/bailer or surge block.
- Direct reading instruments – field instruments to measure pH, conductivity and temperature.
- Water level probe – to measure water level.
- Total depth probe – to measure total depth of well.
- Disposable sampling gloves – to prevent exposure to water and the prevention of cross-contamination.
- Field notebook – for recording field data.
- Clean new twine – for lifting bailer and/or surge block.

3.0 Decontamination Equipment

- 5 gallon buckets – For washing and the collection of rinsate.
- Alconox - Soap
- Scrub brushes – For cleaning sampling equipment.
- Distilled water – For final equipment rinse.
- Culinary tap water – for equipment rinse.
- Garbage bags – for clean equipment storage.

4.0 Procedure

After the monitor well has been installed the well will require development to ensure that all materials introduced during installation are removed and that water entering the well is representative of the aquifer.

Measure the total depth of well with sounding device, measure standing water level and determine well bore volume (V):

V in gallons $=\pi r^2 h \times 7.48$

Where $\pi = 3.14$
r = radius of well casing converted to feet
and h = Water level – total depth of well (determined from drillers log or previous well sounding)

Purge three (3) well volumes of water from the well and measure pH, conductivity and temperature from the 3rd well volume. Continue to purge the well until there are three consecutive readings from the field measurements that have similar values and the water is clear and the turbidity is low. The pH, conductivity and temperature should stabilize when the well is properly developed.

5.0 Documentation

Field activities shall be recorded in a hard bound field notebook and field data sheets. Field notes shall include all pertinent information including but not limited to:

- Water level at start and end of development activities;
- Calculated well volume;
- Log of field pH, temperature and conductivity readings;
- Physical characteristics of water (color and turbidity) during development process;

6.0 Fluid Disposal

All well development purge water shall be disposed of on-site within the tailings impoundment.

7.0 Decontamination

Clean well development equipment according to procedures outlined in RMC SOP 6.

8.0 Demobilization

After Decontamination, sample equipment will be stored in the appropriate, clean containers. Any equipment that suffers damage or excessive wear while conducting sampling will be labeled and reported to the equipment manager for the necessary maintenance, repair and/or replacement.

SOP 3C
STANDARD PROCEDURES FOR GROUNDWATER SAMPLING

1.0 Purpose

This SOP describes the procedures that will be used for collecting groundwater samples. Samples will be collected with a new disposable bailer and/or a Decontaminated downhole pump. Specific monitoring well locations will be determined from the project work plan.

2.0 Sampling Equipment

- Field data sheets / Field notebook / Chain of Custody Forms – Documentation of sample activities, field notes and sample custody.
- Sample containers – Containers provided by laboratory for the collection, storage and transportation of samples.
- Direct reading instruments – field instruments to measure pH, conductivity and temperature.
- Disposable sampling gloves – to prevent exposure to water and the prevention of cross-contamination.
- Custody seals – seals to be placed on sample containers to maintain sample integrity.
- 0.45 um filter apparatus with inert filters – for filtering samples in preparation for the analysis of dissolved metals.
- Nitric acid (HNO_3, supplied by the analytical laboratory) – for sample preservation.
- Distilled water – for rinsing direct reading instruments.
- Water level probe – to measure water level
- Disposable bailers – to extract water from monitoring wells
- Clean new twine – to lift bailers out of wells.
- Downhole pump – if required for deep wells.
- Water level probe – to measure water level.
- Field notebook – for recording field data.

3.0 Decontamination Equipment

- 5 gallon buckets – For washing and the collection of rinsate.
- Alconox - Soap
- Scrub brushes – For cleaning sampling equipment.
- Distilled water – For final equipment rinse.
- Culinary tap water – for equipment rinse.
- Garbage bags – for clean equipment storage.

4.0 Procedure

Unlock and open the well, obtain a water level by inserting a Decontaminated water level probe into the well and measuring the standing water surface to the established datum point on the top of the well head. The established datum point can be installed by using a file to insert a notch in the PVC casing.

Purge the well with appropriate water removal device (Decontaminated bailer/pump or disposable bailer). A total of three well bore volumes of water are normally removed.

Determine the well volume (V) by the following formula:

V in gallons $=\pi r^2 h \times 7.48$

Where $\pi = 3.14$
    r = radius of well casing converted to feet
and   h = Water level – total depth of well (determined from drillers log or previous well sounding)

Pump or bailer discharge during purging is directed to a bucket or container to determine purge rate.

Samples are collected after a sufficient purge volume is withdrawn. Bottles are filled directly from discharge from the well or from another clean container.

After the bottles are filled, the appropriate preservatives are added, if required. The pH level in samples will be verified using pH paper before bottles are sealed.

If dissolved metals analysis is required, filtration is required and the samples will be field filtered. The field filtering methodology will include the following steps:

1: Sample shall be collected in a 1000 ml bottle.

2: Sample is poured into the top of the disposable plastic filter.

3: Vacuum pump is attached to the filter and pumped.

4: When the bottom compartment of the filter is full, the water is to be transferred into a 500 ml sample container which shall be rinsed three times, the sample will be preserved with 2 ml of nitric acid (HNO_3), sufficient to bring the sample to pH <2.

5: The pH level in samples will be verified using pH paper before bottles are sealed.

5.0 Labeling

Each soil sample will be labeled with the following information:

- Sample identification;
- Project number/name;
- Analyses requested;
- Preservatives;
- Date/time collected; and
- Samplers initials

6.0 Documentation

Field activities shall be recorded in a hard bound field notebook and field data sheets. Field notes shall include all pertinent information including but not limited to:

- Date and time samples were collected;
- Physical description of sample area;
- Lithologic descriptions of soils encountered;
- Identification of samples collected;
- Total number of samples collected per sampling event;
- Total number of samples collected from each sample location;
- Physical description of samples;
- Preservatives used for samples;
- Sample container types;
- Analysis to be performed;
- Well construction details;
- Weather conditions;
- Hand sketches of subject area(s); and
- Description and date of any photograph(s) taken.

7.0 Fluid Disposal

All well development purge water shall be disposed of on-site within the tailings impoundment.

8.0 Decontamination

If cross contamination of sampled wells is a potential problem, the following procedure should be followed:

1. Decontaminate equipment according to RMC SOP 6.
2. Design sampling to proceed from best quality water to the poorest quality water.
3. If a pump is used rinse the pumping apparatus if well yields are too low to allow sufficient water to purge the pump.
4. Use one disposable bailer for both purging and sampling per well.

9.0 Demobilization

After Decontamination, sample equipment will be stored in the appropriate, clean containers. Any equipment that suffers damage or excessive wear while conducting sampling will be labeled and reported to the equipment manager for the necessary maintenance, repair and/or replacement.

SOP 4
STANDARD PROCEDURES FOR COLLECTION OF STREAM SEDIMENT SAMPLES

1.0 Purpose

This SOP describes the procedures that will be used for sampling stream sediment to a maximum of 18 inches below surface. Samples will be collected with a decontaminated shovel, stainless steel spoon or hand auger/probe. Specific soil sampling locations will be determined from the project work plan.

2.0 Sampling Equipment

- Field data sheets / Field notebook / Chain of Custody Forms (COC) – Documentation of sample activities, field notes and sample custody.
- Hand Auger/Probe (if necessary) – for the collection of at-depth samples.
- Shovels – for the collection of near-surface samples.
- Log forms / Field notebook / COC – for field documentation.
- Sample containers – for sample storage and transportation.
- Stainless steel mixing bowl – for mixing composite samples.
- Stainless steel sample spoons – for the collection of surface samples and mixing composite samples.
- Disposable sampling gloves – to prevent exposure to soils and water and the prevention of cross-contamination.
- Custody seals – seals to be placed on sample containers to maintain sample integrity.

3.0 Decontamination Equipment

- 5 gallon buckets – For washing and the collection of rinsate.
- Alconox - Soap
- Scrub brushes – For cleaning sampling equipment.
- Distilled water – For final equipment rinse.
- Culinary tap water – for equipment rinse.
- Garbage bags – for clean equipment storage.

4.0 Procedure

Sediment samples shall be collected as discrete grab samples or composite samples. Sample types and frequency shall be specified in the Sample and Analysis Plan.

4.1 Discrete Samples

If water samples are being concurrently sampled with stream sediment samples the water samples will be collected prior to the collection of the sediment samples. Sediment samples will be collected from streambeds with standing water or slow flow rates such that there will be no significant impact while sampling. Vegetation, rocks, and/or debris will be scraped away from the sample location with a shovel or stainless steel spoon. The underlying sediment will then be collected and placed into sample containers with a stainless steel spoon or gloved hand. Composite samples will be homogenized as described below. Coarse grained soils, gravel and rock fragments will be removed wherever possible.

4.2 Composite Samples

Composite samples will be collected (as described above) by placing sub samples into a stainless steel mixing bowl or a clean plastic bag, or by hand with new, clean sampling gloves. The sample will be homogenized with a stainless steel spoon or gloved hand. The homogenized soil will be packaged in a laboratory-supplied sample container, labeled and placed in a cooler to maintain temperature.

5.0 Labeling

Each soil sample will be labeled with the following information:

- Sample identification;
- Project number/name;
- Analyses requested;
- Date/time collected; and
- Samplers initials.

6.0 Documentation

Field activities shall be recorded in a hard bound field notebook and field data sheets. Field notes shall include all pertinent information including but not limited to:

- Date and time samples were collected;
- Physical description of sample area;
- Lithologic descriptions of soils encountered;
- Identification of samples collected;
- Total number of samples collected per sampling event;
- Total number of samples collected from each sample location;
- Physical description of samples;
- Preservatives used for samples;
- Sample container types;
- Analysis to be performed;
- Well construction details;
- Weather conditions;
- Hand sketches of subject area(s); and
- Description and date of any photograph(s) taken.

7.0 Demobilization

After Decontamination, sample equipment will be stored in the appropriate, clean containers. Any equipment that suffers damage or excessive wear while conducting sampling will be labeled and reported to the equipment manager for the necessary maintenance, repair and/or replacement.

SOP 6
STANDARD PROCEDURES FOR DECONTAMINATION

1.0 Purpose

This SOP details the Decontamination protocols for sampling equipment. In order to reduce the risk of transferring materials from one sample site to another, and to assure that there is no cross-contamination of samples, the following procedures will be used.

2.0 Decontamination Equipment

- 5 gallon buckets – For washing and the collection of rinsate.
- Alconox - Soap
- Scrub brushes – For cleaning sampling equipment.
- Distilled water – For final equipment rinse.
- Culinary tap water – for equipment rinse.
- Garbage bags – for clean equipment storage.

3.0 Decontamination Procedures

RMC uses the following decontamination procedure for equipment:

1. Gross contaminant removal

This step involves scrubbing the equipment using an Alconox and water solution and a stiff scrub brush. The scrubbing will continue until all visible contaminants are removed from the equipment. This water will be changed as necessary. The Alconox and water solution is typically prepared and stored in a clean 5-gallon bucket.

2. Clean detergent wash

This step involves using a clean volume of Alconox and water solution. Equipment will be washed in this solution once all gross contaminants have been removed during Step 1. This solution will also be changed as necessary. The Alconox and water solution is typically prepared and stored in a clean 5-gallon bucket.

3. Clear water rinse

This step involves rinsing the equipment in clear, culinary tap water. This water will be changed as necessary to maintain its purity. The water solution is typically collected and stored in a clean 5-gallon bucket.

4. Distilled water rinse

Distilled water will be used as a final rinse for all Decontamination procedures. The water will be poured from a new container, or sprayed from a suitable container or the equipment will be submerged in a suitable container. Decontamination (equipment) blanks will be collected as required in the Sampling and Analysis Plan. The water solution is typically collected and stored in a clean 5-gallon bucket.

4.0 Rinsate Blank Sample Collection

The collection and analysis of rinsate (equipment) blanks is intended to provide information on the cross-contamination and contamination potential introduced by sampling equipment and methods. Rinsate blank sample collection will be performed after decontamination procedures. Rinsate blank sample frequency is specified in the Sampling and Analysis Plan. The rinsate blank sample is collected by running distilled over or through a piece of decontaminated equipment.

The rinsate blank sample collection procedure is:

1. Place the equipment in a catch basin. The catch basin should be made by cutting the top of a 1 liter sample bottle with a decontaminated knife.

2. Pour distilled water over or through the piece of decontaminated samples. To avoid dilution, pour and collect only enough rinsate required for analysis.

3. Transfer the water sample into a laboratory supplied sample container. Refer to RMC SOP 1 for the handling and preparation of the sample.

4. Label the sample with a sample identification that does not identify the sample as a blank.

4.0 Decontamination fluid disposal

Decontamination fluids shall be disposed of on-site in the tailings impoundment area.

SOP 5
STANDARD PROCEDURES FOR SAMPLE HANDLING AND DOCUMENTATION

1.0 Purpose

This section describes the handling and documentation procedures that will be used once soil and water samples are collected. The procedures will ensure that samples are handled properly and that appropriate documentation is completed.

2.0 Sample Handling

All samples will be promptly placed into a cooler to maintain a temperature of 4°C. Typically, samples selected for chemical analysis will be delivered at the end of each day to the analytical laboratory. If they are not submitted to the laboratory on the same day, they will be stored in a refrigerator in a locked storage room until they can be delivered to the laboratory.

3.0 Sample Identification and Labeling

Soil samples will be labeled in such a way as to identify the area and depth from which they were taken. Water samples will be labeled as to identify when and where they were collected from. Duplicate samples will always be labeled in the same manner such that the laboratory cannot tell they are duplicate (i.e., as a "blind duplicate"). Each sample container will be immediately labeled with the following information:

- Project name
- Project number
- Sample identification
- Date and time collected
- Analysis requested
- Filtered or unfiltered (water)
- Samplers initials
- Preservative used (water)

This information will also be recorded in the field logbook and on a Field data sheet.

4.0 Custody Seals

Custody seals shall be used to prevent tampering and to maintain sample integrity. A seal shall be placed across the top of sample jars or across the seals of plastic sample bags. The seal shall placed on the sample container directly preceding sampling and will be signed and dated by the sampler who collected the sampler.

5.0 Chain-of-Custody (COC)

COC documentation will begin in the field for each sample submitted to the laboratory and will also be maintained by laboratory personnel. Samples that are submitted to AEC will use the COC provided by AEC. COC forms will be requested from labs other than AEC prior to sample collection. A COC for each sampling event will be completed and will accompany each sample batch to the analytical laboratory. Sample custody means that all samples will remain in the possession or observation of the sampler at all times, or in a locked facility until delivery to the analytical laboratory. A sample COC form is provided in Appendix D. Copies of the COC forms shall be stored in a three ring binder for sample tracking.

6.0 Field Book

RMC field personnel will maintain a field logbook to record all field activities. The field logbook will be a weather-resistant bound field book. All data generated during the project and any accompanying comments will be entered directly into the logbook in indelible ink; any corrections will be made with single line-out deletions. At no time will any pages be removed from the field logbook.

Each day's field activities will be documented, including the following minimum information:

- Date of field activity;
- Time of field activity;
- RMC field personnel's initials;
- Project name;
- Project number;
- Date and time samples were collected;
- Physical description of sample area;
- Identification of samples collected;
- Total number of samples collected per sampling event;
- Total number of samples collected from each sample location;
- Physical description of samples;
- Preservatives used for samples;
- Sample container types;
- Filtered vs. Unfiltered samples (water);
- Analysis to be performed;
- Weather conditions;
- Hand sketches of subject area(s); and
- Description and date of any photograph(s) taken.

7.0 Field Data Sheets and Borehole/Monitoring Well Logs

Field data sheets will be used to collect and organize data in the field. Field data sheets will be completed for each sample location. Completed originals of the field data sheets shall be placed in a three ring binder and numbered chronologically in a three ring binder to be archived in RMC's office. A set of copies will be stored in a three ring binder for on-site reference.

Borehole/monitoring well logs will be completed for each borehole and monitoring well completed.

Borehole/monitoring well logs and Field data sheets for soil and groundwater sampling are included in Appendix A of this SOP.

8.0 RMC Sample Logbook

RMC will maintain a sample logbook, which will track all samples collected and/or accepted by RMC. The logbook will provide a unique, six digit alphanumeric identifier that will be assigned to each sample collected. All samples collected will be assigned an identifier number, regardless of that samples' submission to a laboratory. The next available chronological number in the sample logbook will determine the identifier, and this number will be cross-referenced with a sample description number, assigned in the field.

The RMC Sample logbook will be a covered, bound journal with non-removable pages. At no time will any pages be removed from the sample logbook.
All entries into the sample logbook will be made in indelible ink; and all corrections shall consist of initialed, line-out deletion. Data contained therein will include:

- Unique identifier number;
- Date;

- Project number;
- Sample description number;
- Sampler initials; and Lab acceptance initials.

Appendix A

Borehole/Monitoring Well Log
Soil Sample Field Data Sheet
Groundwater Filed Data Sheet

RESOURCE MANAGEMNET CONSULTANTS

CLIENT:		BORING ID:
PROJECT:		START DATE:
LOGGED BY:		END DATE:

Graphic Log		Geotechnical		Samples			LITHOLOGIC DESCRIPTION/ COMMENTS
Depth FEET	LITHOLOGY	BLOW COUNTS PER 6"	USCS CLASS	INTERVAL	RECOVERY	SAMPLE ID	
0							
5							
10							
15							
20							
25							
30							

Boring

Total Depth:

Boring Diameter:

Drilling Method:

Drilling Co:

Depth to 1st Water:

Abandonment:

NOTES:

RESOURCE MANAGEMNET CONSULTANTS

Client:	Boring/Monitor Well ID:
Project Name:	Start Date: / / Completion Date: / /
Logged By:	Location: Grade Elev:
	Top Casing Elevation: Static Depth to Water:

Graphic Log			Geotechnical		Samples			LITHOLOGIC DESCRIPTION/ COMMENTS
Depth FEET	WELL WATER LEVEL	LITHOLOGY	BLOW COUNTS PER 6"	USCS CLASS	INTERVAL	RECOVERY	SAMPLE ID	
0								
5								
10								
15								
20								
25								
30								

Boring

Total Depth:

Boring Diameter:

Drilling Method:

Drilling Co:

Depth to 1st Water:

Abandonment:

NOTES:

Well

Total Well Depth:

Surface Completion:

Casing:

Screen:

Bottom Cap:

Gravel Pack:

Annular Seal #1:

Annular Seal #2:

RESOURCE MANAGEMENT CONSULTANTS, INC.
SOIL SAMPLING DATA SHEET

PROJECT:____________________
SAMPLED BY:________________
TIME:_______________________
SAMPLE TYPE:_______________
DATE:_______________________
SAMPLE ID: _________________
DUPLICATE ID:_______________
RMC SAMPLE ID:_____________
WEATHER CONDITIONS: ____

SAMPLE METHOD:____

SITE DESCRIPTION:____
____

FIELD DATA:
GROUND COVER:____
COLOR:____
MOISTURE CONTENT:____

SOIL DESCRIPTION:
____
____
____
____

LABORATORY INSTRUCTIONS:
____
____

SPLIT AND ARCHIVE SAMPLES:___________

INTERVALS SAMPLED:

INTERVAL	RMC SAMPLE ID	COLOR	SOIL TYPE	PARAMETERS

NOTES:

RESOURCE MANAGEMENT CONSULTANTS, INC.
WATER SAMPLING DATA SHEET

PROJECT:____________________ DATE:______________________

SAMPLED BY:______________ SAMPLE ID: _______________

TIME:_______________________ DUPLICATE ID:____________

SAMPLE TYPE:______________ RMC SAMPLE ID:___________

WEATHER CONDITIONS: ____

SAMPLE METHOD:____

SITE DESCRIPTION:____

____

FIELD PARAMETERS:

PH:______________TEMP:_________________COND:______________________

COLOR:________________TURBIDITY:__________________

FLOW DATA:____

____

____

____

WELL DATA:

TD:________ SWL:_______ PURGE METHOD:___________________

VOLUME PURGED:

V in gallons $=\pi r^2 h \times 7.48$

Where $\pi = 3.14$

r = radius of well casing converted to feet

and h = Water level – total depth of well (determined from drillers log or previous well sounding)

________ = 3.14 X ____________^{2} X ________________________ X 7.48

V (GAL) $= \pi$ RADIUS (FT)^2 WATER LEVEL-WELL DEPTH (FT)

BOTTLES COLLECTED:

QUANTITY	SIZE (ml)	FILTRATION	PRESERVATIVE	PARAMETERS

NOTES:

Appendix C
Sample Chain of Custody

AEC LABORATORIES

Laboratory Services Request Form

I. CLIENT INFORMATION	SEND REQUESTS TO:
Client Name: ______	AEC LABORATORIES
Client Address: ______	3422 South 700 West
	Salt Lake City, UT
Client Phone: ______	84119
Client Fax: ______	Your Customer Service
II. ACCOUNT INFORMATION	Representative is:
Account Name: ______	Maureen Ottley
Account Address: ______	Phone # (801) 261-1426
	Fax # (801) 264-9838

P.O. No: ______

III. REPORT INSTRUCTIONS

Report Results To: ______

Report Address: ______

Please Forward Results By: US Mail ( ) Fed Ex ( ) Fax ( ) Other ______

Services Requested below are required no later than ______ (date)

IV. TYPE OF SERVICE REQUESTED

'lease analyze the enclosed environmental samples for:

Lab Use Only Lab No.	Field Sample No./Description	Sampling Date & Time	No. of Cont.	Analysis Requested

Please send the following supplies:

( ) Laboratory Request Forms ( ) Sampling Media (please specify) ______

( ) Other

V. CHAIN OF CUSTODY RECORD

Dispatched by:	Date	Time	Courier Co. Name
Relinquished by:	Date	Time	Airbill #
Received by:	Date	Time	Custody Seal Intact?
Received for lab by:	Date	Time	Yes No

Appendix D
Glossary

GLOSSARY

Accuracy: Ensures how close the results are to a true or expected value and can be determined by comparing the analysis of a standard or reference sample to its actual value.

Aliquot: A measured portion of a sample taken for analysis. One or more aliquots make up a sample.

Bioavailability: A characteristic of a chemical that describes its ability to be absorbed into the tissues or circulatory system of a human or ecological receptor. Bioavailability of metals may be affected by the specific mineral or chemical form and its solubility, environmental pH, the rock matrix, other metals present, the presence of organic material in soil or the receptor's gut, and other factors.

Biota: Any living organisms, including plants, mammals, birds, invertebrates, bacteria, and so forth.

Blind Sample: A type of sample used for quality control purposes, a blind sample is a sample submitted to an analyst without their knowledge of its identity or composition. Blind samples are used to test the laboratory's expertise in performing the sample analysis.
CLP: The EPA's Contract Laboratory Program. The CLP provides analytical services to the 10 EPA Regions through contracted commercial laboratories.

Comparability: The extent to which data can be compared between sample locations or periods of time within a project, or between projects.

Completeness: The comparison between the amount of valid data originally planned to be collected, versus how much was collected.

Concentration: Defined as high, medium, or low, and used to determine how much volume is collected or the analytical protocol to be followed.

Data quality objectives (DQOs): Quantitative and qualitative statements describing the degree of the data's acceptability to the data user(s). They include indicators such as accuracy, precision, representativeness, comparability, and completeness. DQO's specify the quality of the data needed in order to meet the project's goals. The planning process for ensuring environmental data are of the type, quality, and quantity needed for decision making is called the *DQO process.*

Data turnaround time: The maximum length of time allowed for laboratories to submit analytical data to EPA in order to avoid liquidated damages. Data turnaround time begins at the validated time of sample receipt (VTSR) at the laboratory.

Detection limit: Applied to both methods and equipment, the lowest concentration of a target analyte that a given method or piece of equipment can reliably ascertain and report as greater than zero.

Duplicate sample: Used for quality control, two samples taken at the same time from, and representative of, the same site that are carried through all assessment and analytical procedures in an identical manner. Duplicate samples are used to measure natural variability as well as the
precision of a method, monitor, and/or analyst. More than two duplicate samples are referred to as *replicate samples.*

Equipment or rinsate blank: Used for quality control, types of field blanks used to check specifically for carryover contamination from reuse of the same sampling equipment (see *field blank).*

Exposure pathway: The route by which a chemical moves from a chemical source to a living receptor. If the chemical cannot reach the receptor, the pathway is incomplete and poses no risk. If the chemical reaches the receptor but in low enough concentrations, risk may be insignificant.

Field blank: Used for quality control, a field blank is a "clean" sample (e.g., distilled water) that is otherwise treated the same as other samples taken from the field. Field blanks are submitted to the analyst along with all other samples and are used to detect any contaminants that may be introduced during sample collection, storage, analysis, and transport.

Fraction: A specific subunit of an analytical protocol. For example, for low/medium organics, the fractions are volatiles, semivolatiles, and pesticides/Aroclors.

Instrument detection limit: The lowest concentration of a given substance or analyte that can be reliably detected by analytical equipment or instruments (see also *detection limit).*

Matrix: A matrix is a specific type of medium, such as water, soil, or sediment, in which the analyte of interest may be contained.

Method detection limit (MDL): The MDL is the lowest concentration of a given substance or analyte that can be reliably detected by an analytical procedure (see detection *limit).*

Precision: The degree of agreement among repeated measurements of the same characteristic. It may be determined by calculating the standard deviation, or relative percent difference, among samples taken from the same place at the same time.

Preservative: A chemical added to inorganic and volatile water samples to maintain the integrity of the sample. Some common preservatives include nitric acid, hydrochloric acid, and sodium hydroxide.

Quality Assurance (QA): Refers to the overall *management system* which includes the organization, planning, data collection, quality control, documentation, evaluation, and reporting activities of a particular project. QA is designed to ensure that a product or service meets defined standards of quality with a stated level of confidence. -

Quality Assurance Project Plan (QAPP): A formal written document describing the detailed *quality control* procedures that will be used to achieve a specific project's data quality requirements.

Quality Control (QC): Refers to the routine *technical activities* designed to measure quality and limit error in a product or service. Since errors can occur in either the field, the laboratory, or the office, QC must be part of each of these functions.

Quality Control (QC) Samples: Samples used to estimate the precision and accuracy of analytical results in the field and in the laboratory.

Receptor: A living being (or sometimes a significant ecological habitat) that may receive an exposure to a chemical

Representativeness: The extent to which measurements actually represent the true environmental condition or population at the time a sample was collected.

Sample: A single, discrete portion of the environment collected from a specified physical location at a specific time. The single sample may be placed in multiple vessels.

Sample container: The individual bottle that contains the sample or an aliquot of the sample. The type of sample container varies for different sample fractions and concentrations.

Sample custody: Legal possession of and responsibility for a sample. Documentation of sample custody is maintained on the chain-of-custody part of the traffic report or packing list. The sample is in your custody if any of the following criteria are met: 1) the sample is in your possession or is in your view after being in your possession, 2) the sample was in your possession and then locked up or sealed to prevent tampering, or 3) you have placed the sample in a secured area.

Sample label: Taped or adhesive labels that provide the sample numbers to be assigned to the samples.

Sample number: The sample number from the sample label that identifies the sample or an aliquot of the sample.

Spiked samples: Used for quality control, a sample to which a known concentration of the target analyte has been added. When analyzed, the difference between an environmental sample and the analyte's concentration in a spiked sample should be equivalent to the amount added to the spiked sample.

Split sample: Used for quality control, a split sample is one that has been equally divided into two or more subsamples. Splits are submitted to different analysts or laboratories and are used to measure the precision of the analytical methods.

Standard deviation(s): Used in the determination of *precision,* the most common calculation used to measure the range of variation among repeated measurements. The standard deviation of a set of measurements is expressed by the positive square root of the variance of the measurements.

Appendix E
Previous Site Studies

Previous Site Studies

Applied Geotechnical Engineering Consultants, Inc., 1999, Permeability Testing, United Park City Mines/Richardson Flats Property, Summit County, Utah: Consultant's report prepared for LeBOEUF, LAMB, GREENE & MacRAE, L.L.P., January, 1999.

Brooks, L. E., J. L. Mason, and D. D. Susong, 1998, Hydrology and Snowmelt Simulation of Snyderville Basin, Park City, and Adjacent Areas, Summit County, Utah: State of Utah Department of Natural Resources, Technical Publication No. 115, 84 pp.

Dames & Moore, 1973, Report of Ground Water Monitoring and Seepage Study, Tailings Pond Development, Near Park City, Utah: Consultant's report prepared for Park City Ventures Corporation, December, 1973.

Dames & Moore, 1974, Report of Embankment and Dike Design Requirements, Proposed Tailings Pond Development, Near Park City, Utah: Consultant's report prepared for Park City Ventures Corporation, March, 1974.

Dames & Moore, 1980, Report of Tailings Pond Investigation, Near Park City, Utah: Consultant's report prepared for Noranda Mining, Inc., November, 1980.

Ecology and Environment, Inc., 1985, Analytical Results Report, Richardson Flats Tailings, Summit County, Utah: Consultant's report prepared for U. S. Environmental Protection Agency, Region VIII, Waste Management Division, TDD #R8-8508-07.

Ecology and Environment, Inc., 1989, Supplemental Site Inspection Report, Richardson Flats Tailings, Summit County, Utah: Consultant's report prepared for U. S. Environmental Protection Agency, Region VIII, Waste Management Division, TDD #F08-8903-06, PAN FUTOO39HDA.

Ecology and Environment, Inc., 1993, Final Report, Richardson Flats Tailings, Summit County, Utah: Consultant's report prepared for U. S. Environmental Protection Agency, Region VIII, Waste Management Division, TDD #T08-9204-015 and #T08-9210-050, PAN EUTOO39SBA and EUTOO39SDA.

Pioneer Technical Services, Inc., 1993, Comments Regarding: Final Report, Richardson Flats Tailings, Summit County, Utah, Dated February 19, 1993 and Prepared by Ecology and Environment, Inc.:
Consultant's report prepared for United Park City Mines Company, December, 1993.

Weston, Inc., 1996, Baseline Risk Assessment, Murray Smelter.

Appendix F
Laboratory QA/QC Documents

Section 1.1
Frontier Geosciences' Quality Assurance

1.1.1 Frontier Geosciences' QA Policy Statement

Quality Assurance (QA) is a system for ensuring that all information, data, and interpretation resulting from an analytical procedure are technically sound, statistically valid and appropriately documented. Quality Control (QC) is the mechanism used to achieve quality assurance.

Frontier Geosciences Inc. (Frontier) has a strong commitment to quality assurance, both at the bench and the management level. Frontier realizes that without quality control, data may become suspect and of less value to our client. Frontier is therefore dedicated to producing data of highest quality, usability, and coherence.

Data quality is achieved through Frontier's Data Quality Objectives (DQO's). Our DQO's consist of five components: precision, accuracy, representativeness, comparability and completeness (PARCC).

- Precision is a measure of how repeatable data is and is often measured by sample replicates.
- Accuracy is a measure of how close the data is to the actual, or real value, measured by certified reference materials and matrix spikes.
- Representativeness is a measure of how representative a sample is to the sample population and is achieved by accurate, artifact-free sampling procedures and appropriate sample homogenization.
- Comparability looks at ongoing projects and how variable one set of data is to another. Comparability helps to measure the scientific coherence of the system to past work .
- Completeness is a measure of how many data points collected are usable; Frontier considers 95% usable data to be an acceptable value for completeness.

Frontier routinely provides data packages in one of three QA formats. The first, called "Screening Level", is equal to US EPA Level 1. "Research Level" is between US EPA Levels 2 and 3, while the third, called "Litigation Level" is approximately equivalent to the US EPA Level 4. In addition, Frontier will provide custom QA/QC packages to meet the individual needs of the client. The various QA/QC levels above "screening level" do not represent differences in analytical data quality, but rather, the degree of documentation provided, and therefore the ability to defend the data in legal proceedings. The quality of the data produced under QA reporting schemes above the screening level, as measured by quantitative indicators such as precision, accuracy, and detection limits, are equivalent.

1.1.2 Frontier Geosciences' Quality Assurance Policy

Frontier recognizes that accurate and precise data depends upon an effective and consistent QC program. Frontier's program is implemented collaboratively by the entire laboratory group and subscribes to the following basic tenets:

> Sample integrity must be preserved. Integrity is preserved by following documented sample handling procedures for the preservation, custody, storage, labeling and record keeping of samples received by the laboratory.
>
> Trace metal-free ("ultra-clean") sample handling must be employed. All samples to be analyzed for low level or ambient metals concentrations are handled according to protocols: including the use of our class-100 clean room, wearing of clean room gloves, and using only pre-tested and approved reagents, water, and equipment. High-level (contaminated) samples are kept segregated from ultra-clean samples during storage and sample preparation.
>
> Approved analytical methods must be followed. The analyst's fundamental understanding of analytical methods is paramount for effective, first-defense QC. Emphasis on understanding and following the correct methods is part of every analyst's training. QC results from each method are evaluated to identify and correct method weaknesses, and to detect any need for further training.
>
> Analytical instrumentation must be in proper working order. Optimum instrument performance is assured by the use of daily calibration and performance evaluation samples. Rigorous preventative maintenance is performed on a regular basis and is well documented.
>
> Raw data must be properly reduced and accurately transcribed into the correct reporting format. Various levels of data review, from acquisition to the final report, are performed to minimize error.
>
> The laboratory-specific precision and accuracy of analytical methods must be documented and monitored continuously. Accuracy and precision are monitored and compared to historical data from Standard Reference Materials (SRM's). All data is scrutinized according to our scientific understanding of the biogeochemistry of the particular situation. **The scientific coherence of the data set is considered to be as important a QA parameter as precision or accuracy.**

Section 1.2
Corporate Ethics Policy on Fraud, Waste, and Abuse

1.2.1 Environmental Responsibility

As an environmental science research company and specialty laboratory, Frontier aspires to be a model of environmental responsibility. Thus, employees should be ever-vigilant to avoid waste, conserve resources, reuse, recycle, and minimize the production of hazardous wastes. The procedures used in a modern scientific laboratory often employ toxic materials and disposable items. Therefore, employees are encouraged to develop innovative ways to minimize the production of these materials, while finding safe ways to reuse disposed of items (plastic bags, bottles, unused chemicals, etc.), once their laboratory usefulness is finished.

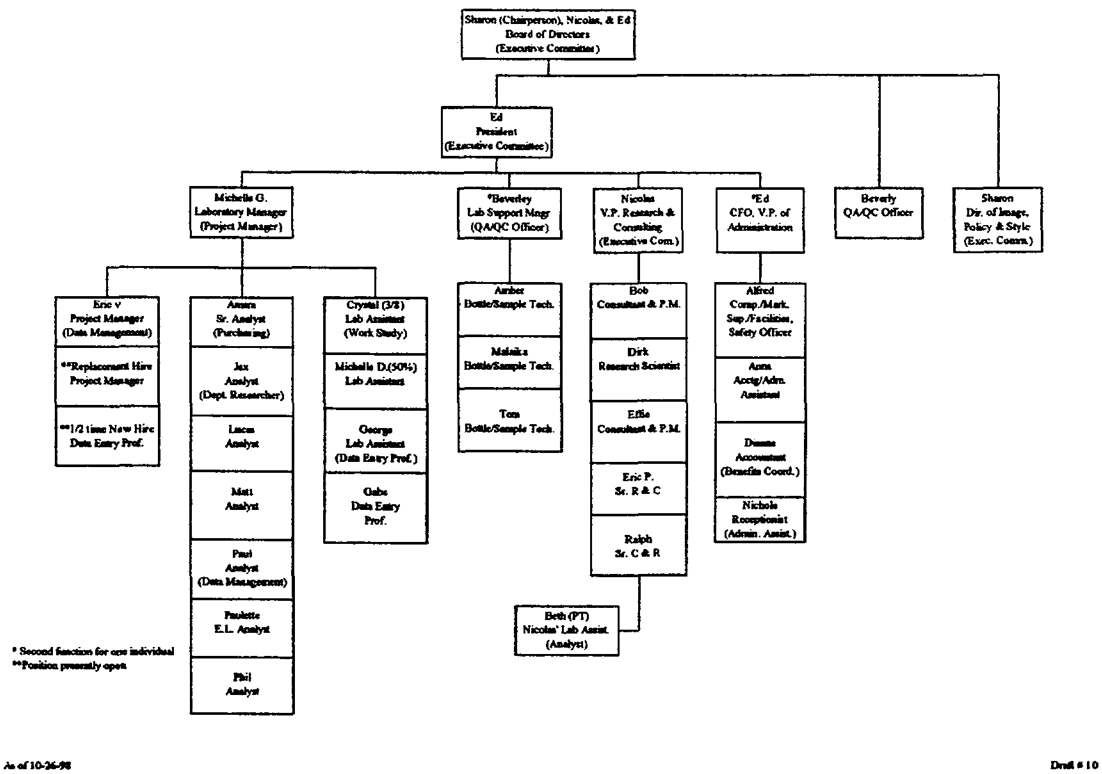
1.2.2 Intellectual Honesty

Frontier performs environmental research for government, industry, academic institutions, and environmental activist groups. Hence, it is important for the company's credibility that all reported results and interpretations be objective and honest. Although individuals within the company may differ on the political implications of various results, Frontier must remain above this in its data and research. All obtained results must be reported with complete honesty, with no regard to the expected, or preferred (by client or researcher) outcome. In the case of researcher-selection of "best" or "most accurate" data from an analytical set, all assumptions used in choosing data or rejecting data, must remain readily available to the sponsor and/or outside review. Fabrication of data or its deliberate misinterpretation is considered grounds for immediate employment termination.

All employees are required to adhere to Frontier's Intellectual Honesty policy. Any employee witnessing an act that may be considered to go against the Intellectual Honesty policy is required to report the instance to management. The reporting employee may maintain anonymity. Several avenues are available to employees wishing to report suspect behavior: they may directly confront the offending employee, they may report the instance to the employee's direct supervisor, the lab manager, the president or the QA officer. There may be times when the decision to reject data is not absolutely clear. Any time the decision is ambiguous, the decision must be made with management consent. Unambiguous decisions need not be overseen, or explained, but all data must be presented and noted on the original data set. The important factor is that management become aware of the situation and that all employees feel comfortable reporting suspect behavior.

Section 2.1
Frontier Geosciences' Organizational Chart

Frontier Geosciences Inc.



Frontier subscribes to a relaxed hierarchy, where teamwork is more important than job status. The lab manager oversees the entire lab on a day to day basis. All technical employees report to the QA officer and lab manager about QA issues. The lab manager is able to answer questions regarding quality assurance issues if the QA officer is out. The QA officer works with the lab manager to implement and assure QA policies.

Laboratory personnel are responsible for quality control at the bench level. Frontier considers the analyst as the first line of defense. Quality control is then looked at by the lab manager. Finally, each dataset's quality control measures are reviewed by the QA officer, who is the last line of defense for quality control before the data is sent to the client. The client performs a final review of the data when he/she receives it. For projects less than level 4 QA, the samples may be discarded after the project manager and QA officer have reviewed the data, but before the client has done so (unless special provisions for sample archiving were made in advance). For litigation level QA work, any requests to re-run the sample must come within one month of report submission. If re-run results are equivalent to initial results, the client assumes responsibility for paying for the extra work. Frontier will answer QC related questions after one year of report submission if the client is willing to pay for the time.

In addition, if any employee feels that the appropriate person is not fixing a given problem, the employee may speak to the lab manager or QA officer, enlisting their aid in getting the issue resolved.

Section 2.2
Frontier Geosciences' Personnel Qualifications

Scientific Staff	Highest Academic Degree	Responsibilities
Nicolas S Bloom, Sr. Research Scientist	MS Oceanography 1987	mentoring, business dev., supervision, research
Ralph R. Turner, Sr. Research Scientist	PhD Oceanography 1975	research, consulting, field work
Eric M. Prestbo, Research Scientist	PhD Chemistry 1992	research, consulting, field work
Efrosini Tsalkitzis, Research Scientist	MS Biology 1995	research, consulting, staff biologist
Dirk Wallschläger, Post-Doc Researcher	PhD Natural Sciences 1996	research, methods development
Robert C. Brunette, Research Scientist	BS Chemistry 1993	research, consulting, field operation
Michelle L. Gauthier, Lab Manager	BS Chemistry/Physics 1992	laboratory management, project management
Eric J. von der Geest, Project Manager	BS Chemistry & Math 1993	mercury project management, computer resource
Amara M. Vandervort, Sr. Analyst	BS Biology & Psychology 1994	sample prep and analysis supervision, field work
Jacqueline G. London, Analyst, Research Specialist	BS Chemical Engineering 1996	sample prep and analysis, research
Paul Laskowski, Analyst	BS Chemistry 1990	sample prep and analysis, computer resource
Matt Horrobin, Analyst	BS Honors Biology 1989, PGCE	sample prep and analysis
Phil Kilner, Analyst	BS Environmental Science 1997	sample prep and analysis
Lucas Hawkins, Analyst	BS Chemistry 1993	sample prep and analysis
Paulette Jones, Entry-Level Analyst	MS Environmental Science 1997	sample prep
George Scriba, Lab Assistant, Data Entry Prof.	BS Environmental Science 1996	sample prep, misc. laboratory duties, data entry
Crystal Howard, Lab Assistant (student)	BS Geology 1999 (to be awarded)	sample prep, misc. laboratory duties
Gabriel Choy, Electronic Data Deliverables Specialist	AA Art 1996	data entry, peer-review of datasets
Michelle Dedman, Lab Assistant	BS Zoology 1982	sample prep, misc. laboratory duties
A. Malaika Lafferty, Technical Specialist & Sample Custodian	High School Diploma	laboratory equipment processing, sample receiving, shipping
Amber Steward, Technical Specialist & Sample Custodian	BS Geological Oceanography 1998	laboratory equipment processing, sample receiving, shipping
Thomas E. Smith, Technical Specialist & Sample Custodian	High School Diploma	laboratory equipment processing, sample receiving, shipping

Administrative Staff	Academic Degree	Responsibilities
Sharon K. Goldblatt, CEO	BS Human Development 1987	P.R., administration, marketing, editing
Ed G. Geiger, President & CFO	MBA (CPA, Retired) 1983	financial mgt., administration, marketing
Beverly A. Heaphey, Quality Assurance Officer	BA Philosophy 1990	quality assurance and control
R. Dianne Shepard, Accountant & Benefits Admin.	BA Education 1974	accounts receivable, payroll, general ledger
Anna M. Cortez, Administrative Assistant	AA General Studies 1992	administrative duties, accounts payable
Alfred Rordame, MIS, Safety Officer	BUS Choreography and Composition 1983	safety coordination, facilties mangmnt, computers, graphics

Section 2.3
Facility Description and Capital Equipment

2.3.1 Facilities

Frontier's laboratory and office facilities are in downtown Seattle, Washington. The location is close to Sea-Tac Airport, and the University of Washington.

The space contains a small (100 ft^2), clean room, four mercury analysis laboratories (c.a. 500 ft^2 each), four sample preparation rooms (c.a. 200 ft^2 each), two graphite furnace AA laboratories, an ICP-MS laboratory, an atmospheric reactions laboratory, a conference room/library, and ten staff offices.

The laboratories are served by a custom-designed HVAC system with ESP pre-cleaners, providing an atmosphere that is clean and well isolated from outside dust and dirt. Each laboratory atmosphere is routinely monitored for Hg in the gas phase, and appropriate action is taken if it exceeds 25 ng/m^3 in any location, or 10 ng/m^3 in the clean room. Frontier uses an acid neutralization discharge systems for liquid acid-waste disposal. Disposal of toxic materials is carried out under contract to a certified disposal company.

The offices are equipped with document production equipment: laser printers, document and image processing software, color printer, large capacity collating copier, and a binding machine. A network connects personnel computers and printers for local access, as well as allowing for external email and faxes. Frontier has a Fed-Ex Powership shipping computer and access to Fedex pick-up as late as 5:00 PM Pacific Coast time.

The entire Frontier space has been inspected and passes all city and state code requirements for fire, emissions, and low level radioactive samples.

Frontier owns all necessary equipment for ultra low level trace metal research.

2.3.2 Security

Access to Frontier offices and laboratories is regulated and limited to authorized personnel. During normal work hours, when the front office is staffed, visitors are required to check in and sign the guest list if they have not previously done so. All visitors, including delivery personnel, must be accompanied by an employee in the laboratory. The outside front door and the two back doors are kept locked at all times. Visitors must first press the Frontier button on the building's security door buzzer system outside the main entrance, identify themselves, and then be admitted by an employee-actuated electronic door lock release.

All computers are backed up five days per week onto the main system, which is stored in a fire-proof safe. Backup tapes are rotated on a five day schedule, so that at all times backups are insured for the last five business days. Once a month, a tape is taken to a safety deposit box and stored there.

Employee safety is an important concern to Frontier. In addition to the overall facility security system, Frontier also has two remote alarms. The alarms are worn around the neck, and alert the police when activated.

2.3.3 Frontier Geosciences' Capital Equipment

Qty.	Description	Manufacturer
4	Cold Vapor Atomic Fluorescence Hg Detector	Oriel/Frontier-built
3	Cold Vapor Atomic Fluorescence Hg Detector	Tekran
4	Isothermal GC for Hg Speciation	lab-built
2	0.1 mg Analytical Balance	VWR
2	0.01 g Lab Balance	VWR
2	Class 100 Clean Air Hood (4' and 2')	Labconco
4	Class 100 Clean Bench (6' with gold Hg scrubber)	Labconco
1	Milli-Q 50 Reagent Water System	Millipore
2	Ultra-Pure Reagent Water System	US Filter
1	Large Volume Water Deionization System	US Filter
10	Macintosh Computer (networked + e-mail)	Apple
23	IBM Compatible Computer (486 processor)	Toshiba
1	Zeeman 5000 GFAAS + Hydride System	Perkin-Elmer
1	4' Hg-Free Nitrogen-Purge Glove Box	Labconco
1	Large Volume Centrifuge (250 mL bottle)	Centra
1	Tungsten Carbide Ball Mill	Spex
6	Dual Pen Chart Recorder	Kipp & Zonen
2	Chromatographic Integrator	Hewlett-Packard
7	Constant Temperature Lab Ovens	Precision
6	5 Tube Methyl Hg Distillation Units	lab built
2	Muffle Furnace	Precision
6	Refrigerator/Freezer (sample storage)	Whirlpool
5	Complete sets of fluegas sampling equipment	Frontier-built
24	Teflon® bulk deposition collectors	Frontier-Built
>500	Ultra-Clean Teflon® Bottles, various sizes	Nalgene
>1000	Ultra-Clean Teflon® Vials, various sizes	Savillex
1	Dissection Microscope	Leica
1	Specific Ion/Conductance/pH Meter	Orion
1	UV-VIS Spectrophotometer	Spectronic
1	Low Level Ozone Analyzer/Calibrator	Dasibi
10	Digital Mass Flowmeter	Sierra
1	4110 ZL Atomic Absorption Spectrometer	Perkin-Elmer
1	ICP-MS ELAN-6000	Perkin-Elmer
1	PSA "Excalibur" HGAFS system (As, Se, Sb)	PSA

Section 2.4
Frontier Geosciences' Preventative Maintenance

The responsibility for preventative maintenance belongs to the laboratory group leader. Verification that preventative maintenance is being performed is the responsibility of the QA Officer. Logbooks for each instrument are maintained, and a central file is located in the QA officer's office to document major actions. Preventative maintenance procedures are laid out according to the type of instrument.

Mercury Analyzers:

Daily - Make sure work area is clean
Check all traps and bubblers for particulate contamination
Clean bubblers at the end of the analytical day
Monitor gold trap performance for blanks, reproducibility, recoveries
Test and/or replace degraded traps as needed
Every 3 months - Thoroughly clean analyzer

AA:

Daily - Clean contacts
Clean analyzer windows
Weekly - Compare slopes
As needed - Routine service contract for cleaning, testing and/or service

Balances:

Daily - Check with ASTM Class 1 weights
Every 6 months - Certified calibration performed

Pipettes:

Weekly - Calibration checked
As needed - Pipettes are taken apart and cleaned

pH meters:

Before each use - Calibration checked
Every 6 months - Certified calibration performed

Clean Hoods:

Weekly - Outside air filters cleaned
Monthly - Pre-Hepa filters checked
As needed - Pre-Hepa filters changed

Section 3.1
Frontier Geosciences' Corrective Action

3.1.1 Qualified Data Corrective Actions

In the event that a breech of security or other out-of-control event occurs before sample receipt at the laboratory (e.g., custody seal is broken, samples received do not match the COC, cooler temperature or preservation status not as specified in SOW or COC, etc.), the discrepancy will be noted in the receiving logbook, on the COC form, and in the project file, by the sample custodian. The project manager or laboratory manager will then be immediately notified. The manager will contact the client immediately, via fax or telephone, to decide upon a plan of action. In the intervening time until the client can respond, the samples will be held in secure storage under conditions appropriate for the sample type (i.g., in refrigerator for water samples, in freezer for frozen samples, etc.). If the client cannot be reached within reasonable sample storage time, the analyst and lab manager will use their best judgment on deciding what course of action to take.

If there is any suspicion that a sample set may contain radioactive, dangerous or toxic materials, high levels of gaseous mercury, unsterilized human or primate blood, tissues, excreta, or any other threat to the health or cleanliness of the laboratory or its staff, the sample container will be immediately closed up, placed in a secure storage area outside the building, and the safety manager immediately notified. The client will be immediately contacted via fax or telephone, to decide upon a plan of action. Under no circumstances will processing or analysis of the samples begin until the client can certify the safety of the materials. If the client cannot do so, the samples will be returned exactly as received.

3.1.2 Analytical Issues

Any data that is analytically suspect due to laboratory problems, biogeochemical improbability, poor precision or accuracy on QA samples will be qualified (flagged) and an explanation will be included in the case narrative. If the sample is re-analyzed, all results will be presented on the original data set with an explanation as to why the laboratory selected specific certain results over others. It is initially the task of the analyst to identify any out-of-control occurrences and immediately notify her/his supervisor and/or the lab manager, to obtain further instructions. If the incident appears to be a unique random occurrence (e.g., a low LCS recovery) the sample will be re-run as soon as possible. If upon re-running the sample an acceptable result is obtained, and no other out-of-control events occur in the data set, the data set will be considered valid and in control. If multiple out-of-control QC results, and poor system calibration, or any other suspected systematic analytical problems are observed, the analyst will immediately suspend further analysis, and contact the project or laboratory manager. The analyst, under the manager's direction, will then investigate the probable causes of the system failure, correct them, and then successfully re-calibrate and QC-test the system before continuing to analyze samples. Occurrences of this type will be noted in the case narrative, and all data collected while the system was out-of-control will be either discarded or reported and flagged and the instance noted in the corrective action file.

Once the data has been checked and found to be in control by the analyst, it is submitted to the project manager, who makes the formal calculations of results, notes any QC sample discrepancies (low SRM's, high blanks, etc.), and any problems generated from field QC samples (field duplicate precision), or problems related to scientific coherence (i.e., out-of-place results in a depth vs. concentration plot, methyl Hg higher than total Hg, etc.). For suspect samples, the raw data and analyst notes are first consulted to help resolve the discrepancy (i.g., is it plausible that the error is due to a sample labeling mix-up, transcription error, etc.?). If the project manager feels that one or more samples should be re-analyzed based upon his/her evaluation, a written note is placed in the project file, and a re-analysis request is made to the analyst. When the re-run results are evaluated by the project manager, she/he will make a decision as to which data to retain or flag, and that will be noted in the case narrative.

3.1.3 Data Package Verification

On litigation level QA projects, before submission of final results to the client, the raw data package and calculated results are submitted to the QA officer. The QA officer or his/her delegate checks over the package to be sure all QC samples have been run and are within internal and/or client specifications. An exception to this would be for fast turn-around-time projects, when an "un-revised" report is initially sent and then later backed up with a reviewed, revised version. At this time, approximately 5% of the calculations are rechecked for errors. If none are found, the package is cleared for final submission. If errors are found, the entire package is rechecked, and a memo of discrepancies is sent to the project manager for rectification. The project manager then writes the final report, noting any unresolvable QC issues, and qualifying any data, if necessary, in the case narrative.

On some litigation level QA data packages, the final step in the QA/QC process occurs with the independent validation of the data package by the client. If discrepancies or concerns are noted by the independent validator, they are communicated in a formal letter to the project manager, who then investigates and explains each result in a formal response. If any of the results are changed (e.g., due to calculation or transcription errors), the affected pages of the final report are modified, annotated with the revision date, and re-submitted. It is Frontier's convention to report all data to one more significant figure than is warranted by the precision and accuracy of the methods employed (typically three figures). **It is further the position of Frontier that discrepancies of up to 5 units in the last significant figure, typically attributable to numerical rounding differences between Frontier and independent QC validators, need not be rectified, as they are meaningless to the interpretation of the data. This position results in significant savings in personnel resources for both Frontier and the client.**

3.1.4 Sample Re-Analysis

Frontier will normally, if sufficient sample volume remains and if the degree to which the samples are out-of-control warrants, re-analyze, at our cost, all suspect results on our own initiative. Upon agreement of the sponsor, we will also re-run analyses at sponsor request, but if the re-run data supports the notion that poor results were due to natural or client causes rather than laboratory causes, the client must pay for those additional requested analyses. Further, it is our position that if data is slightly outside QC bounds, but that lower quality does not materially affect the overall data interpretation, the results should not be re-analyzed at Frontier cost, but rather flagged as approximate.

3.1.5 Corrective Action Reports

In all cases where investigation by the project manager or the QA officer results in data being changed, qualified, or in samples being re-analyzed, a written note will be placed in the client file, and a copy placed into a chronological "Corrective Action File" maintained by the QA officer. These reports are the basis for corrective actions by the project manager and her/his staff, and for notations in the project case narrative. Once the QA issue has been investigated, resolved and/or corrected, a response describing the course of action and final result is appended to the original corrective action report.

Infrequent, random, and singular out-of-control events (e.g., a single low spike recovery), which are not part of a trend, are not considered evidence that the system is out-of-control. However, the QA officer must keep a record of such events (in control charts, for example), to assure that their frequency is maintained at less than 5% (running average n>100 occurrences). Occurrences of greater than 5% random deviations from acceptable control limits in any monitored parameter are considered an "out-of-control" condition, and analysis is stopped until the cause is identified and rectified.

3.1.6 Control Charts

In addition to project-specific QC corrective actions, the project manager and QA officer will maintain records of key analytical parameters (i.e., SRM's, spike recoveries, RPD results, blanks) as control chart files. The control chart files are updated weekly, and control chart analyses conducted on a monthly basis. The QA officer or the project manager may elect to perform specific control chart analyses more frequently to ascertain if any trends in data quality are developing. Examples of data not included in control charts include: data from highly contaminated soils or other very inhomogenous materials, values close to the MDL, spikes too close to the sample concentrations, specialty (rarely used) and/or research-only methods, samples, etc.

Section 3.2
Frontier Geosciences' Laboratory Audits

3.2.1 Internal Audits

On a quarterly basis, the QA officer will conduct an internal laboratory audit, (FGS-041), via review of all control chart information, logbook entries, and client specific QA issues and corrective actions. In addition, he/she will take a detailed unannounced walk-through inspection of the laboratories, noting the QA and safety practices of the staff. Randomly requested data packages will be reviewed with the project manager to verify the accuracy and retrievability of particular data points, starting with raw data records (only litigation level data can currently guarantee this). The internal audit may also include submission of blind performance evaluation samples. These findings will then be evaluated by the QA Officer, reviewed by the laboratory manager, and discussed at a general staff meeting, with commendations and recommendations for areas of improvement. If any serious breaches of safety or QA practice (i.e., fire hazard, toxic fumes, poor calibration results, high water or air Hg levels, etc.) are noted during an internal audit or at any other time, all affected laboratory work will immediately be ceased, the health and safety officer notified and a meeting will be called to resolve the matter. Once the system has been brought back into control, routine work is allowed to continue and the incidence is noted as soon as possible in the corrective action file.

3.2.2 External Audits

Frontier views external audits as a form of free consultation and welcomes the opportunity to improve the quality of the lab. External audits are conducted at the discretion of the client, either prior to award of a contract, or as part of an ongoing laboratory monitoring process. Such audits may include submission of blind Performance Evaluation results, control chart information, data packages for complete independent validation, or a complete personal walk-through interview by the client QA representative. The laboratory may also be audited pending application for government certification, safety, or environmental regulation. Records of all such audits, their findings, and the corrective actions taken will be maintained in chronological order by the QA officer. In addition, health and safety related documentation will be retained by the health and safety officer. A copy of each project-specific audit will also be maintained by the project manager in the appropriate project file.

Performance Evaluations are performed twice a year. Samples from the Washington State PE program and from the APG program are analyzed and compared to other labs. In addition, other round-robin performance evaluations and regular performance evaluations will be conducted at the client's request or as deemed necessary by the lab manager.

Section 3.3
Quality Assurance Reports to Management

The QA officer is responsible for preparing a quarterly report. The purpose of the report is to present QA issues to the scientific staff in a condensed, graphical representation. The report should include at a minimum: changes in quality assurance, quality control changes, audit report findings, and control charts detailing current issues of interest or problem areas. The main objective of the monthly report should always be a tool to the scientific staff, helping them recognize trends and/or trouble spots. These quarterly reports should summarize and draw attention to quality control issues, both good and bad.

Section 3.4
Lab Documentation and Forms

Lab documentation and forms are created on an as-needed basis. The creator of the form is responsible for checking to see if the new form is replacing an old form. The new form is placed into the central Form Library and if it is replacing an old form, the old form is removed and discarded. The creator of the new form is also responsible for putting the new form into the computer system's file server. If it is replacing an old form, the old form is deleted (old forms are retained in back-up files). The creator of the new form then e-mails all staff informing them of the change.

All newly created forms are given a version number and date. This will assist staff and clients in recognizing current versus old forms. All newly created forms have Frontier's name on them, as well as the revision date and form number. If it is recognized that an old form is being used, then the person who noticed it is responsible for replacing the old form with the new version. It is the responsibility of all laboratory personnel to ensure that clients are receiving the new versions.

The QA officer maintains a document management file, wherein all major forms (i.g. SOP's, QAP's and QAM's) are logged out of the office so that when new versions are created, the correct persons may receive the new copies.

Section 3.5
Sub-Contracting of Services

On occasion, Frontier finds it necessary to sub-contract services for specialty analyses that we do not perform. We do not send overflow of samples within our expertise to outside labs. When this happens, Frontier will first contact the client and inform them of the situation and obtain their permission to sub-contract the work. Frontier will then contact laboratories that it usually uses and request their services. If they are not able to meet our needs, we will look for other laboratories. In either case, Frontier will remain ultimately responsible for the samples and results. Laboratory integrity and competence are of utmost importance and our paramount concern. When using another lab's services, Frontier routinely sends, along with the samples, blind spiked samples and blanks to double-check and enforce the quality and integrity of the other laboratory's technical work. In addition, Frontier maintains a copy of the sub-contracted laboratory's quality assurance plan, performance evaluation results, and some of their benchsheets, to further ensure the quality of the other laboratory.

Section 3.6
Staff Training and Documentation

3.6.1 Hiring Process

People often begin their careers at Frontier as temporary employees provided by employment agencies. Under these circumstances, screening and reference confirmation is undertaken by the agency, and copies of that information are retained in the person's newly created employee folder. If/when the employee becomes permanently hired by Frontier, she/he signs the agency information, and those papers are returned to the personnel file. Even in situations where Frontier finds the employee directly, an employment agency may be used as a screening and payroll service for a temporary period.

New employees hired directly by Frontier provide documentation of skills they already possess via publications, detailed resumes, letters of recommendation, and self-certification. Subsequent staff training is documented via training checklists and written management and/or peer reviews, which are maintained in chronological order in the personnel files. Every staff member is formally evaluated quarterly using a combination of self and supervisor evaluation. Job descriptions are reviewed and may be updated at that time.

3.6.2 Training

Employees trained in a new skill learn by a mentorship process. The employee is assigned to a staff member, who teaches each method as follows:

a) First familiarization with the equipment/process by observation
b) Detailed reading of the SOP and attendant literature references
c) Second familiarization with the equipment/process by observation
d) Supervised practice of the method using standards and SRM's
e) Unsupervised practice of the method on standards/SRM's
f) Blind re-analysis of actual project samples, which have also been independently analyzed/processed by the mentor
g) Evaluation of the blind intercomparison by the new staff member, mentor, and laboratory manager.
h) Supervised analysis of low QC level samples or samples generated by internal research projects.

Completion of these steps is documented using a training checklist, signed by the trainee and by her/his supervisor. Once the new employee has successfully inter-compared on at least ten samples (i.e.; all results are found to replicate the mentor's results within ± 20%) he/she is considered trained in that task, and a note is placed in her/his personnel file.

For newly trained employees, pertinent QC data is reviewed on a daily basis by the laboratory manager or project supervisor for a period of at least one week, until the supervisor and/or laboratory manager is satisfied that the employee is competent in the procedure.

As the employee sets up her/his equipment and begins to obtain actual data, ongoing performance evaluations occur via control chart information, inter-laboratory intercomparison exercises, and blind Performance Evaluation (PE) samples documenting precision and accuracy. Records of performance are submitted by the staff member and/or supervisor (quarterly basis) to the lab manager, for inclusion in the staff member's personnel file.

Training documentation differs according to employment category. Principle Investigator's training is primarily documented by the quantity and quality of peer-reviewed literature and complete client reports. For technical staff, Frontier relies on documented analytical performance criteria (accuracy and precision on blind samples). Copies of all documentation are maintained by the QA officer.

3.6.3 Seminars and Meetings

Records are also maintained on all seminars, classes, and training sessions attended by each employee. On a yearly basis, all staff attend at least one safety seminar and one QA/QC review seminar, where current practices and new procedures are discussed and overall laboratory compliance is reviewed. In addition, Frontier holds monthly public seminars. The topic of the seminars varies from month to month and speakers may be invited from outside sources or may be internal staff. Finally, occasional, internal seminars are presented with speakers from outside the company or from within, on specific applied topics of interest.

In the event that any serious safety or QA/QC deficiencies are discovered by the lab manager, or if a new employee is hired, or if new project-specific requirements are mandated, a staff meeting will immediately be called to provide the appropriate information and establish any required protocols. The agendas from all Frontier staff meetings which include training issues, health and safety or discussion of QA/QC concerns will be signed by the attendees, and copies will be retained in personnel files.

Section 4.1
Frontier Geosciences' Sample Handling Procedures

4.1.1 Sample Receipt and Holding Time

Samples are delivered to the sample receiving area and may be accepted by any staff employee. Because the samples are sent by overnight carrier, signing the receipt and the COC form upon delivery fulfills the Chain-of-Custody requirement. The sample custodian opens the cooler, which may or may not be sealed with a client-supplied custody seal, checks the condition of the samples (intact, temperature, broken, leaking, etc.), and notes observations on the COC form and in the sample receipt log.

If the samples are from a contaminated or potentially radioactive site, the contents will be pre-monitored for the appropriate contaminants prior to unpacking by the health and safety officer. If the contents contain substances in concentrations which might contaminate the laboratory, endanger personnel or the environment, the container will be re-sealed, placed in a secure outside storage area, and the client notified.

The sample custodian verifies that each container is properly labeled and sealed, and compares the sample identification with the COC form. If Frontier bottle numbers are not utilized by the sampling crew, the sample custodian correlates these numbers with the client numbers directly on the COC form. If the sample identifications and the COC do not match, or if the seals on any of the containers are broken, the sample custodian notifies the laboratory supervisor.

4.1.2 Sample Tracking Procedures

Once the samples have been examined and their labels compared to the COC form, their information is entered into a master receipt logbook along with the client or project name, date and time received, matrix type, and any special client notes or anomalous observations. Each sample is assigned a unique laboratory sample identification number. In general, the sample tracking number is the client ID number, or, if the sample is in a Frontier provided Teflon® bottle, the engraved bottle number is the sample tracking number. Damaged samples are disposed of in an appropriate manner, and the laboratory supervisor and the project manager are notified (please see Frontier Geosciences' Hazardous Materials Management Plan for more information on sample disposal). The system for tracking samples through preparation and analysis consists of COC records, sample receipt logbook, project logbook, laboratory worksheets, laboratory notebooks, instrument operation logbooks, instrument printouts (raw data), and final analytical reports. Because the laboratory is small, secured, and the analysts/sample receipt personnel are in constant communication, no additional internal chain-of-custody documentation is maintained.

4.1.3 Sample Transport, Preservation and Storage

Special consideration is given to the procurement, storage, and transportation of samples to be analyzed. These procedures enhance the probability that any analyte originally present in the sample matrix will not degrade or alter in concentration, and that contaminants that might interfere with the analysis have not been added. For low level (ambient) mercury work, only rigorously acid-cleaned Teflon® containers (or Borosilicate glass or quartz containers with Teflon® lids) may be used for water, as outlined in Table 4.1.

Tissues, sediments, and contaminated water samples should be stored in acid-cleaned glass containers with Teflon® lids. The client is responsible for potential sample contamination resulting from the use of polyethylene, polypropylene, or other plastics not approved for mercury work. Aqueous samples are sent unpreserved by overnight courier, while solid samples are preserved by freezing in the field unless specifically requested otherwise. Each sample container is sealed inside a zip-loc bag which is labeled with a unique sample number and geochemically relevant information (location, depth, date, etc.). After the samples are logged in, rinsed and dried, the sample custodian transports them to the refrigerator, freezer, or shelf space designed and allocated for sample storage. All company employees have access to the sample storage area, which is within the (locked) analytical laboratory.

Summary of Containers and Preservatives
Table 4.1

(G=Glass with Teflon® Lids, T=Teflon®, P = Polyethylene, GT=Gold Trap, CT=Carbotrap, IC=Iodated Carbon, KCL/Lime=KCL/soda lime, IX=Ion Exchange Membrane, QFF=Quartz Fiber Filter).

Parameter	Min. Vol.	Container	Preservative	Hold Time**
Tissues, Sediments				
All Metals	1 g	G,T	Freeze	1 year
Water				
[a]Total Hg	100 mL	T	0.5% HCl	28 days
Se IV and VI	100 mL	G	0.5% HCl	3 months
Non-Hg Metals	200 mL	T,G,P	0.1% HNO_3	6 months
Methyl Hg	50 mL	T	0.5% HCl	6 months
Dimethyl Hg	500 mL	G	1°C, Dark	48 hours
Elemental Hg	500 mL	G	1°C, Dark	48 hours
As(III)/As(V)	200 mL	P	-196°C Freeze*	3 months
Dissolved/Particulate	250 mL	T	1°C, Dark	48 hours
Air				
Total Hg	10 L	G,T	none	6 months
Methyl Hg	10 L	CT	1°C, Dark	7 days
Dimethyl Hg	10 L	CT	1°C, Dark	48 hours
Gaseous Hg (II)	10 m^3	IX	20°C, Dark	7 days
Particle Hg	10 m^3		20°C, Dark	7 days
Flue Gas				
Total Hg/Hg°	15 L	IC	none	30 days
Methyl Hg	60	KCL/Lime	none	30 days
Ionic Hg	15 L	KCL/Lime	none	30 days

**Holding times are as specified unless previous approval is given by the client. This approval may be in written or verbal form.

[a]Also good for all other trace metals.

*If freezing is not possible, then 0.5% HCl, 1°C, dark.

NOTE: **Samples may <u>not</u> be packed in vermiculite, as the dust from this material represents a contamination risk. The client should use bubble wrap or foam as packing materials. All samples known or suspected to contain high mercury levels, or any other hazardous**

constituents, must be so identified. Failure to do so may result in additional costs and the return of the samples, as well as liability for damages or injuries which result.

4.1.4 Chain of Custody for Samples in the Laboratory

A sample is considered to be "in custody" if it meets the following criteria:

a) It is actually in the analyst's possession.
b) It remains in the analyst's visual range once possession of the sample has been assumed.
c) The analyst has locked or sealed the sample to prevent tampering.
d) The sample has been stored in a secure area.

To satisfy these custody provisions, the laboratory implements the following procedures:

1. Samples are stored in a secure area.
2. Outside laboratory doors are locked at all times.
3. Visitors are accompanied by a laboratory staff member.
4. Samples remain in the secure area until acceptance of the final report by the client.

Aside from signed and dated records of activities in the lab note books, bench sheets, and sample prep logs, no additional internal chain of custody documentation is maintained.

4.1.5 Sample and Waste Disposal

Samples must eventually be disposed of to preserve laboratory storage space. Proper disposal is emphasized for the sake of efficiency, and, in the case of hazardous substances, safety. On litigation level QA projects, samples are stored for 30 days following submission of the final report unless the client requests otherwise. For levels 2 QA and below, samples may be disposed of immediately following data review, with permission of the group leader or lab manager. Disposal is notated on the sample chain-of-custody form. (Please see Frontier's Hazardous Materials Management Plan for detailed information on hazardous waste disposal.) **Frontier will not accept hazardous samples without prior agreement that the client is responsible for sample handling and disposal after the analytical report has been provided. Exceptions may be made if prior arrangements are approved by the lab manager and the health and safety officer. Frontier reserves the right to reject any samples that may pose a reasonable threat to the health or safety of personnel (for example, unsterilized human biological tissue, radioactive materials, unknown industrial wastes, etc.)**

Section 4.2
Frontier Geosciences' Analytical Procedures

The analytical procedures used at Frontier (Table 4.2) are derived from peer-reviewed literature representing state-of-the-art methods, and are thoroughly tested prior to adoption as Frontier SOP'Ss. The analytical methods used are generally not EPA approved techniques, as Frontier methods operate with lower detection limits, more wide-ranging chemical speciation, and/or greater precision than currently approved EPA techniques.

Recently, however, the method used for total Hg in water (FGS-011) has been given interim approval by the US EPA as Method 1631, and the method used for ultra-clean sampling (FGS-007) as Method 1669. Frontier has been commissioned by the EPA to write more methods in the 1600 series, relating to ultra-clean techniques. When conducting direct injection graphite furnace AAS, Frontier closely follows EPA protocols (Method 200.1). Our method for total arsenic by hydride generation (FGS-022) is functionally equivalent to EPA Method 1632.

Frontier's methods are periodically reviewed and updated to represent the latest thinking of the research community and/or to improve the economics of performing the analyses. Before new procedures are implemented, the analyst conducts the analysis at least three times using standards, spikes, and duplicates in order to establish reproducibility. Once the procedure is properly understood by the analyst, high quality data has been achieved, and it is approved by the lab manager, a standard operating procedure (SOP) is written for the method.

SOP's are given a numerical number that is sequential to the other SOP's. All SOP's are given an SOP number and revision or creation date. The QA officer is responsible for assigning the SOP number and then making sure that the new SOP is followed by laboratory staff. The QA officer is also responsible for checking the document management file and sending out the new version to all applicable persons.

On a yearly basis, new SOP's and versions of SOP's will be compiled and made into an SOP appendix or new SOP manual, depending on how many revisions and newly created SOP's there are.

Literature and SOP References to Analytical Procedures

Table 4.2

Parameter	Frontier SOP	Literature Reference
Total Hg	FGS-009 FGS-011 FGS-012	Bloom, 1993 Bloom & Crecelius, 1987 Bloom & Crecelius, 1983 Fitzgerald & Gill, 1979 US EPA Method 1631
Methyl Hg	FGS-010 FGS-013 FGS-017 FGS-018	Liang, Horvat, and Bloom, 1994 Horvat, Bloom, and Liang, 1993 Bloom, 1989 Bloom and Fitzgerald, 1987
Labile Hg(II), MMHg	FGS-034	Bloom, 1994
Flue Gas Hg	FGS-023 FGS-024 FGS-031	Prestbo and Bloom, 1995 Bloom, 1993
Ultra-Clean Sampling	FGS-007 FGS-008	Bloom, 1995 Fitzgerald and Watras, 1989 Gill and Fitzgerald, 1987 Patterson and Settle, 1977 Bothner and Robertson, 1975 US EPA Method 1669
Ultra-Clean Filtration	FGS-029	Bloom, 1995 Bloom and Effler, 1990
Selenium Speciation	FGS-037	Cutter, et. al, 1986
Arsenic Speciation	FGS-022	Crecelius, et. al, 1986 US EPA Method 1632
Trace metals by GFAAS	FGS-020 FGS-021 FGS-032	Slavin, 1984, US EPA 200.1 Bloom and Crecelius, 1984

Section 4.3
Frontier Geosciences' Calibration Procedures

4.3.1 Standards and Instrument Calibration

Every instrument used to analyze samples at Frontier must pass the calibration criteria established in the appropriate operating procedure document. Initial calibration criteria for instrument reproducibility and sensitivity must be met before samples may be analyzed. Continuing calibration checks establish whether ongoing instrument calibration is acceptable or not. Detailed presentations of Frontier's analytical instrument calibration procedures are provided in SOP's FGS-001 and FGS-020.

All calibration standards are obtained from chemical suppliers and are of high purity and concentration. The standards are routinely checked by the laboratory for traceability to National Research Council of Canada (NRCC) or National Institute of Standards and Technology (NIST) Standard Reference Materials (SRM's). Solutions are normally labeled as follows: name of solution, concentration of solution, date prepared, analyst's initials, and expiration date (if needed). A certificate attesting to the concentration ranges of the covered analytes is maintained in a central Frontier file, entitled "Standard Certificates."

4.3.2 Periodic Calibration Procedures for Other Laboratory Equipment

Periodic calibrations are performed for associated equipment that are required in analytical methods but are not routinely calibrated as part of the analytical procedure. Such equipment includes balances (daily, FGS-002), pipettes (prior to first daily use, FGS-003), ovens (when in use), refrigerators and freezers (daily, FGS-004), and the water purification system (daily). All calibration measurements are recorded in laboratory logbooks.

4.3.3 Supplies, Reagents, Water

All supplies (e.g., glassware, chemicals, reagents, etc.) are of the best possible quality to ensure proper instrument calibration and to avoid contamination. All reagents used are prepared from analytical reagent grade chemicals or higher purity grades, unless such purity is not available. Reagent (18 meg W) water is prepared at Frontier by double deionization of filtered tap water. Each reagent is clearly labeled with the composition, concentration, date prepared, initials of preparer, and expiration date, if necessary. Reagents that have a long, unquantified shelf life, and standards, which are re-calibrated monthly, are not given expiration dates.

Reagent solutions are stored in appropriate glass or plastic containers, under conditions designed to maintain their integrity (refrigerated, dark, etc.). Reagent solutions are checked for contamination before use in any analysis. If known to be finite, shelf life is listed on the label. Expired reagents are appropriately discarded. To avoid chemical waste and excess pollution, chemicals and standards with no known storage shelf life are kept indefinitely, except at specific contractor request. All acids for trace metal analysis other than mercury are either glass-distilled or of special grade for trace metals analysis.

Laboratory water is double deionized and checked at least weekly for mercury concentration. Our goal is to maintain [Hg] at less than 0.2 ng/L and MMHg at less than 0.01 ng/L. In the event that concentrations are observed above 1.0 ng/L for total Hg and 0.025 ng/L for MMHg, all low level analysis is discontinued until the problem is identified and remediated.

The laboratory air is monitored for mercury on a monthly basis, both in the clean room and in general laboratory space. The quality maintenance standard levels for the clean room and laboratory air are 5 and 10 ng/m^3 respectively, with corresponding action levels of 15 and 30 ng/m.

Acid-cleaned sample bottles are stored with 0.5% HCl for Hg, As, and Se, and 0.5% HNO_3 for other trace metals. At least six bottles per week are randomly selected and the acidified water contents checked for mercury (EPA 1631) or trace metals scan by ICP-MS. Control charts will be kept of these data points for the following metals: Hg, As, Se, Zn, Cu, Pb, Cd, Ni, Fe. The occurrence of contamination (Hg > 1 ng/L, all others > 0.5 µg/L) must be maintained with a running frequency of less than 3% of bottles tested. Each new lot of EPA-clean ("I-CHEM") bottles of each size will be tested for Hg by filling with 0.5% BrCl in distilled water. These values will be logged. Any lot found to contain blanks of > 1 ng/L will not be used for low-level work.

Section 4.4
Data Precision and Accuracy

4.4.1 Calibration Checks

Calibration check samples are used to verify the standard calibration curve. At least one check sample is analyzed with each batch of samples at the beginning of each calibration period. Calibration check samples can either be prepared in the laboratory (additional standards) or are available as Standard Reference Materials (SRM's) from the NRCC or NIST. Performance Evaluation samples serve as an accuracy check of laboratory operations and measurement systems by comparing results with those of other laboratories. The experimental results of the check sample are compared with the true values, and the percent recovery of the check standard is calculated. If the percent recovery falls within the acceptance range, then sample analysis proceeds. However, if the percent recovery does not fall within the acceptance range, the sample is run again, and if it still does not fall within the acceptance range, the problem is identified, corrected, and the instrument calibration sequence begins again.

SRM data is maintained chronologically in a computer database, and control charts are examined on a weekly basis to assess long-term laboratory performance trends. The control chart is used to assess trends, and therefore a single deviant point will not be considered evidence that an analytical procedure is out-of-control. If, however, two or more points in any five day period are found to be more than three sigma away from the long-term mean for that parameter, the analytical procedure will be considered out-of-control, and all analyses halted until the problem is identified, corrected, and a triplicate analysis of that parameter is found to be in control. In cases where two or more QC points are found to deviate by between two and three sigma over a five day period, the system will be considered under probation, and additional QC checks will be performed. If, over another five day period, performance continues to give results greater than two sigma from the mean, the system will be considered out-of-control. In all cases where >95% of all QC measurements over a given period for a method are within two sigma of the long-term mean (or certified range, whichever is smaller), then the system shall be considered in control.

Data collected from inter-laboratory intercomparisons and performance evaluation (PE) samples are maintained by the QA officer. In the event that a result from such a sample deviates from the acceptance or group mean interval reported, the source of the discrepancy will be located, and corrective action will be taken. Aliquots of all PE and intercomparison samples will be retained until the group results are reported so that the samples may be re-run if necessary.

4.4.2 Matrix Spike/Duplicate Spike Analysis

For litigation level QA work, and any new sample matrix/analyte combination, one in every twenty samples will be analyzed with a matrix spike and matrix spike duplicate. In this type of analysis, predetermined quantities of stock analyte are added to a sample matrix prior to sample extraction or digestion and subsequent analysis. Because the nature of such digest is well understood in the case of simple total metals digestions, the matrix spike can be added to the digest after digestion, but prior to dilution, unless specifically disallowed by contract language. This procedure allows initial analysis of samples to calculate appropriate spiking levels.

Percent recovery is calculated for the amount of added analyte detected. Spike recoveries of 75-125% (70-130% for MMHg) are considered acceptable. The relative percent difference between the samples is calculated and used to assess analytical precision (see Duplicate Samples, Section 4.4.4). The concentration of the spike should be 2-5 times the expected concentration of the analyte in the unspiked media. In general, this means that MS/MSD analyses will be performed after the unspiked samples are analyzed, and the concentrations calculated.

For levels of QA other than litigation, the client or project manager will specify spiking frequency.

4.4.3 Duplicate Samples

Duplicate samples provide information about sampling plus analysis precision and accuracy. Duplicate samples may be either true duplicates or split samples. True duplicates are two samples collected from a common sampling location in two independent sampling events. Ideally, these samples should have identical compositions, although in fact, a degree of field variability always contributes to the observed difference between duplicates. Split samples are one or more sub-samples of a homogeneous sample. These samples should be identical in concentration, and are a direct indicator of analytical-only precision. However, in the cases of unhomogenizable samples, such as Hg^0 contaminated soils, splits will be considered as functionally equivalent to field duplicates. The frequency of duplicate sample collection and analysis is specified in the contract with the client. Typically, one duplicate or split sample is performed per twenty samples collected, or one per sampling event, whichever is more frequent. The relative percent difference (RPD) between the two values is calculated as 2*(R1-R2)/(R1+R2). The RPD for sample splits must be <25% at concentrations greater than 10 times the MDL to be considered in control. The laboratory has no control over field and sampling induced variability, and so the relative precision of field duplicates may be viewed as serving informational purposes only.

Section 4.5
Frontier Geosciences' Quality Control Checks

4.5.1 QC Samples

The laboratory uses QC samples to assess validity of the analytical results of field samples. QC samples include method blanks, calibration checks, performance evaluations, duplicates, and spiked samples. QC samples are analyzed in the same manner as field samples, at a frequency described either in the individual procedures, or in the contract with the client. If the QC sample results fall within the acceptance criteria (also detailed in the method or prescribed by the client), then the field sample data is considered to be valid or acceptable as-is. Unless specified otherwise by the client, the acceptance criterion for data based on QC samples is specified in the SOP on Calibration Procedures (FGS-001), and in Table 4.3. These criteria are followed per set for litigation level QA and per day for research level QA. Of particular importance to the client is Frontier's position that a **single non-compliant result on a QC sample does not automatically invalidate a data set.** If the other QA data in the same data set is of acceptable quality, and a re-run of the out-of-control sample is also of acceptable quality, then the entire data set is considered to be in control and acceptable.

4.5.2 Method Blanks

A method blank is a sample of reagent water or analytical reagents that undergoes the same analytical process as the corresponding field samples. Method blanks are used to monitor laboratory performance as well as to detect contamination that could have been introduced during the analytical procedure. For litigation level work, a minimum of three method blanks are required per batch, or one per ten samples, whichever is higher. For research level QA, the number of blanks required is determined by the project manager based upon historical information on blank values for the same analytical method, and the expected concentrations in the samples. All Frontier results will be reported as corrected for the mean of the method blanks analyzed with the samples, unless previously specified by the contract language.

4.5.3 Certified Reference Materials (CRM's)

Frontier maintains the position that matrix equivalent CRM's are the best measure of precision and accuracy, as problems associated with homogeneity and spikes not matching the true analyte forms are avoided. Unfortunately, CRM's do not exist for all matrices. Frontier will utilize CRM's at a rate of 1 per

20 samples or 1 per set, whichever is greater, whenever the appropriate matrix is available (sediments, tissues, sewage sludge, sea water).

4.5.4 Interlaboratory Intercomparisons

For matrices where no CRM's are available at ambient levels, Frontier will endeavor to participate in at least one interlaboratory intercomparison or round robin per year. These include low level speciation of Hg, As, and Se in water. In addition, Frontier routinely participates in several interlaboratory intercomparisons per year, including the EPA's WP series, APG, and USGS.

Litigation Level
QC Requirements for Data Validation
Table 4.3

QC Requirement	Minimum Frequency	Limits
all standards, force through zero	min. 4 points/day	r > 0.995
continuing calibration	1 per 10 samples	80-120% of initial slope
laboratory duplicate	1 per 20 samples	± 25% RPD @ > 10xMDL a
method blanks[a]	3 per batch or 1 per 10 samples, whichever is greater	a
Standard Reference Material	1 per dataset	a
matrix digestion MS/MSD	1 per 20 samples	75-125% Rec. a
ongoing precision and recovery	as stipulated by contract language	
low-level spike recovery	as stipulated by contract language	
filtration blanks	as stipulated by project manager	

[a]Numeric values in corresponding SOPs

Section 4.6
Data Reduction, Review, and Verification

After the data has been acquired, and any necessary calculations performed, the initial review is performed by the analyst. Items included in the review include: sample identity, peak height verification, instrument calibration, QC samples, detection limits, numerical computations, accuracy of transcriptions, and compliance with the individual method. For research level QA projects, this is the full extent of the formal data review. Screening level data verification is dependent upon the project, but is generally less stringent than research level data verification.

On litigation level QA projects, following the analyst's review, the QA officer or his/her designate reviews 100% of the raw data, the analyst's chemical interpretation and any out-of-control conditions that may be identified by the analyst (FGS-038). Additionally, the QA officer examines the QC sample data and ensures that the analytical results are within Frontier-prescribed criteria for accuracy and precision. Finally, as specified by the client, the data may be further reviewed by the client, or by an independent data validator.

Data verification is part of the review process whereby data is inspected and either accepted or rejected based on a set of criteria. Evaluation parameters that can be used for validation include, but are not limited to the following:

a) Performance on SRM's (precision and accuracy)
b) Calibration data
c) Specific checks unique to each measurement

Section 4.7
Data Reporting

Data is reported using a format specified in the client's contract. Data is generally reported via US Mail or 2nd day Fed-Ex in tabular form with a case narrative and/or cover letter attached. All of the data, including standard spike recoveries, control samples, duplicate analyses, and results from blank analyses, is reported along with the sample results in the calculation spreadsheets. Samples re-run for reasons of analytical error (i.g. spiked incorrectly, pipetting error, aliquot too large or too small, gas flow problem, etc.) will not be addressed in the sample report. Samples with results that are unaccountable to physical, laboratory problems, will be addressed in the sample report. All requests for sample re-runs for litigation level work must come within 30 days of report submittal. The detection limits of an analytical procedure are reported if the analyzed value is less than the detection limit. Footnotes are referenced to specific data if an explanation of reported values is required. All the reports are signed and transmitted by the project manager or designee. If previously negotiated, data may be transmitted via electronic media (diskette, modem, e-mail, fax), and/or in specific formats (i.e., Excel file, ASCII, etc.). Negotiable aspects may include the additional cost of specific computer programs, equipment, or on-line services. Our guaranteed turn-around-time for a summary data report is four weeks from receipt of the last sample in a set, with the full QA report coming no more than two weeks later. Generally a faster response time is achieved (1-2 weeks), especially for research level projects.

QC Documentation Provided with Frontier Data Packages

Table 4.4

Document	Abbreviated Package	Full Package
Chain-of-Custody Form	archived	provided
Analytical Bench Sheets	archived	provided
Sample Prep Logbook	archived	at client request
Raw Data	archived	at client request
Uncorrected results	not provided	provided
Corrected results	provided	provided (unless specified)
QC data	summary	complete
Case narrative	abbreviated	complete
Instrument Logs	not provided	at client request
Reagent Prep Logs	not provided	at client request
Control Chart data	not provided	at client request
Phone/Fax Records	not provided	at client request
Data Interpretation	at client request	at client request

Thank you for your time and effort in reading this document. We at Frontier Geosciences Inc. realize that technical documents are not always the most entertaining papers to read and we are constantly striving to be as succinct and readable as possible. Your comments are most welcome and encouraged. Please feel free to call, fax or email Beverly A. Heaphey, Quality Assurance Officer, with any questions, comments or suggestions.

phone: (206) 622-6960
fax: (206) 622-6870

email: bevh@frontier.wa.com

ASARCO/AEC

QUALITY ASSURANCE MANUAL

LABORATORY QUALITY ASSURANCE PROGRAM

Reviewed Vince Kelk 1-05-01
Laboratory Coordinator

Approved Gary Stz 1-05-01
Laboratory Manager

Laboratory Quality Assurance Program

Attachments

INTRODUCTION

Quality assurance has always been an important part of laboratory operations at ASARCO Inc./AEC. The following program describes the quality control procedures designed specifically to meet or exceed EPA, OSHA and various states requirements for an environmental chemistry laboratory. The program addresses the following areas: I) Goals and laboratory quality control policy; II) Personnel and training; III) Sample custody, sampling techniques and preservatives; IV) Sample receipt and log-in procedures; V) Flow of samples through the lab; VI) Analytical methodology and instrumentation; VII) Quality control and performance requirements VIII) Data reduction and validation; IX) Analytical reports and other deliverables, and; X) Standard operating procedures. The quality assurance manual is available to all personnel and is located in the supervisor's office.

I. GOALS AND LABORATORY POLICY

The purpose of the ASARCO/AEC Quality Assurance Program is to insure that all data generated and processed is scientifically valid and of known precision and accuracy. It is the policy of the laboratory to meet, as a minimum, all of the criteria set forth in this program or the method specific QC criteria and to insure that approved procedures and QA data are satisfactorily documented. The Quality Assurance manual is reviewed and approved on an annual basis by laboratory management. The effectiveness of the program is measured by means of a systems audit conducted on an annual basis by the QA coordinators. A written report of the audit findings is provided to the Analytical Services Manager. In addition, quarterly quality assurance update reports are prepared by the QA coordinators and submitted to the Analytical Services Manager.

II. PERSONNEL AND TRAINING

ASARCO field service staff, technicians and outside consulting field service personnel operate independently of the laboratory. These individuals consult with laboratory personnel and staff environmental scientists on issues such as sample volume requirements, containers and methods of preservation.

All laboratory personnel participate in an extensive on the job training program tailored specifically to the individual chemical analysis. This in-house training consists of acquiring an in-depth understanding of the appropriate methodology (eg: EPA, NIOSH and OSHA procedures) and applying these procedures to synthetic standards, standard reference materials and various other check samples prior to the analysis of unknowns. Each analyst is also required to attend laboratory safety training seminars on a quarterly basis. In addition, analysts are encouraged to attend training seminars conducted by analytical instrument manufacturers. Training records are kept on file in the manager's office. An organizational chart and laboratory personnel responsibilities forms can be found in attachment #1.

III. SAMPLING TECHNIQUES, PRESERVATION AND SAMPLE CUSTODY

Samples are taken, labeled, preserved and prepared for shipment by qualified personnel usually under the direct supervision of the on-site environmental scientist using the EPA approved procedures listed in 600/4-79 Revised 1983 and SW 846 Third Edition; NIOSH Manual of Analytical Methods, Third Edition; and the OSHA Manual of Analytical Methods. Specific chain of custody procedures are followed utilizing the form included as attachment #2.

IV. SAMPLE RECEIPT AND LOG-IN PROCEDURES

The samples are shipped by common carrier, next day service in appropriate shipping containers such as insulated ice chests. The samples are sent to one of the following individuals:

Ms. Maureen Ottley
Customer/Systems Support Rep.
c/o ASARCO Incorporated
3422 South 700 West
Salt Lake City, Utah 84119

Ms. Jodie Haynes
Customer/Systems Support Rep.
c/o ASARCO Incorporated
3422 South 700 West
Salt Lake City, Utah 84119

Upon arrival, the shipment is inspected for completeness by the sample custodian. Chain-of-custody forms are signed as evidence of receipt and accompany samples and login/chain-of-custody work sheets while in the laboratory. The samples are then individually logged into the ASARCO Laboratory Information Management System (LIMS).

The log-in program assigns a unique lab number to each sample and prints login/chain-of-custody work sheets for each batch of samples with all pertinent information (see attachment #3). The samples are then logged into a hardbound logbook listing the computer assigned batch number, client, date of receipt, the number of samples in the batch and the matrix (see attachment #4). The condition of the shipping and sample containers are noted on the log-in checklist along with preservation parameters (see attachment #5). Field personnel are notified immediately of any inconsistencies with the chain-of-custody forms or problems regarding the condition of the sample containers or sample preservation.

V. FLOW OF SAMPLES THROUGH THE LAB

The login/chain-of-custody work sheets are given to the analyst(s) assigned to the project along with the corresponding samples. Samples are analyzed in accordance with the methods listed in Section VI of this manual. The samples are kept either in a locked refrigerator (if appropriate) or in the custody of the analysts while they are being worked on. All necessary sample and analytical information is logged in ink into a hardbound laboratory workbook (see attachment #6). This may include raw analytical data, graphs, calibration curves, quality control information, sample preparation and/or digestion procedures and any comments. All calculations such as adjustments for dilutions or concentrations, unit changes, etc. are made in this book. Any corrections are made by drawing a single line through the entry, and placing the revised entry to the side. The correction is initialed and dated. Unused portions at the bottom of a page are to have a single line extending from the last entry to the bottom of the page. Upon completion of analyses the sample and quality control data are logged into the LIMS by the analyst and a final report is generated. Water samples and digestates are stored for approximately two months after the final report has been sent. Miscellaneous and solid samples (eg. soils, solid waste, filters, etc.) are stored indefinitely. Samples for disposal are disposed of in accordance with all local, state and federal regulations.

VI. ANALYTICAL METHODS AND INSTRUMENTATION

The procedural and instrumentation manuals are available to the analyst in the supervisor's office at any time. For projects requiring contract laboratory protocol, the CLP ILM03.0 is followed. Other frequently used references are the EPA's "Methods for Chemical Analysis of Water and Wastes", 6009/4-79 Revised 1983, "Test Methods for Evaluation of Solid Wastes", SW846; "Standard Methods for

Water and Wastewater" 19th Edition and the NIOSH Manual of Analytical Methods. Methods are thoroughly tested using matrix matched standard reference materials or other materials of known composition to insure accurate and precise results before testing of unknowns is conducted.

The analytical instrumentation is operated in accordance with the manufacturer's guidelines to obtain the desired sensitivity. One example of this would be the use of the Perkin-Elmer "cookbook" for samples analyzed by atomic absorption spectrophotometry. Method detection limits are compiled annually and an example is included as attachment #7. Instrument standards are used on a daily basis to determine response and calibration of the instruments. These standards are traceable to high purity stock material utilizing a unique numbering system and documented in a hardbound logbook (refer to section VII). All calibration information is documented in the analyst's workbook and available for review.

Instrumentation maintenance records and service agreements are kept on file are included as attachment #8. Operating and routine maintenance SOP's are are in the ASARCO Laboratory Operations manual and on the company's intranet. Calibration and maintenance procedures are documented for support equipment such as balances and micro pipettes. Defective equipment is removed from service until repaired.

Instrument detection limits and linear dynamic ranges are determined in accordance with method specific requirements.

VII. QUALITY CONTROL AND PERFORMANCE REQUIREMENTS

Following is a summary of the ASARCO laboratory QC program:

1. Instrument Calibration and Acceptance Criteria

   For atomic absorption spectrophotometry, a blank and three standards in graduated amounts must be used. Standards absorbance values will be recorded and a correlation coefficient of .995 or better must be achieved. At least two standards must be used for ICP calibration. One of the standards must be a blank. Interference check samples (ICS's) are performed daily and must be within + or - 20%. Calibrations will be conducted daily and each time the instrument is set up. Initial calibration verification (ICV) is conducted with an independent reference standard immediately after instrument calibration and must be within + or - 10%.

Continuing calibration verifications are conducted at a frequency of 1 in 10 and also must fall within + or - 10%. Initial calibration blanks (ICB's) and continuing calibration blanks (CCB's) are conducted at the frequency as the ICV's and CCV's, and are to fall within + or - the reported limit of detection.

2. Quality Control Samples

The table on the following page summarizes the type and frequency of QC samples normally used to validate. Also included are control limits and corrective action procedures.

The analysts are largely responsible for monitoring trends and trouble shooting problems with laboratory supervision in the role of reviewing the program and providing assistance in trouble shooting more difficult problems. Quality control charts are included as Attachment #9. As part of the laboratory alert system, quality control data, which are out of acceptable limits, are automatically flagged via the statistical quality control program and action taken in accordance with the control loop (see attachment #10).

On rare occasions when samples are sent to other laboratories, synthetic standards, NIST type certified materials, duplicates, and blanks are sent to monitor the quality of the data returned. In addition, only properly accredited and/or certified laboratories are used.

3. Proficiency Testing

The laboratory participates in many inter-laboratory proficiency testing programs. Proficiency test samples are analyzed in a manner similar to routine samples. The following is a list of current programs:

AIHA Proficiency Analytical Testing Program (PAT)

ELPAT Program for soil, paint and wipes

ERA WP Program

Ambient Source Sampling Audits (by EPA) for lead

The laboratory adheres to the following guidelines regarding proficiency testing:

- Conduct proficiency testing for each analyte or where proficiency testing is not available, maintain appropriate validating documentation.

- Conduct proficiency testing at the certifying agencies required frequency.
- Utilize an approved proficiency testing service.
- Follow proficiency testing provider's analyzing and reporting instructions.
- Notify certifying agency of a change in provider.
- Maintain a copy of all proficiency testing records.
- Submit corrective action to certifying agency for values outside acceptable limits.

4. <u>Laboratory Reagents and Standards Log and Traceability</u>

All laboratory reagents are to meet or exceed the quality specified by the method. Generally, unless a higher grade is recommended, reagents are ACS grade or better. For all standards the following information will be recorded in the appropriate standards logbook and on the standards bottles:

1) Date of preparation
2) Acid matrix of standards
3) Concentration of standards
4) Initials of the analyst preparing the standard
5) Source of standards

Laboratory reagents are inspected, dated and initialed upon receipt. Reagents are not used beyond theexpiration date (eg. pH buffer solutions) or if the internal QC suggests a problem. Intermediate reagent containers are labeled with the following information:

1) Date of preparation
2) Matrix
3) Concentration
4) Initials of the analyst

Item number 5, <u>Source of Standards</u>, requires some specific guidelines to ensure a consistent, useable method of traceability. All standards are made from high purity metals and confirmed by third party reference materials or previous standards. Purchased standards are NIST traceable. Standards are not used beyond expiration dates or if the internal QC's (eg. ICV's or LCS's) suggest a problem.

<u>Source of Standards for Stock Solutions</u> will be conducted as follows:

Laboratory SOP's	Location
Sample Preservation	Quality Assurance Program, Section III
Sample Custody	" "
Holding Times	" "
*Sample Receipt	Quality Assurance Program, Section IV
Sample Handling & Distribution	Quality Assurance Program, Section V
Sample Preparation and Analyses	Quality Assurance Program, Section VI
*Standard Traceability & Source	" "
Laboratory QC Samples	Quality Assurance Program, Section VII
Data Assessment	Quality Assurance Program, Section VIII
Data Validation	" "
Data Useability	" "
Data Generation	Quality Assurance Program, Section IX
Sample Storage Sample Disposal Glassware Cleaning Sample Digestion	Posted or Distributed as Necessary

*Also posted or distributed.

FIELD SOP'S

The following field SOP's are addressed by the sampling contractor and are to be included in the project specific sampling and laboratory QAPP:

- -Sample Collection
- -Field Log Book
- -Sample Packaging
- -Field Measurements
- -Consumable Procurement
- -Documentation
- -Sample Shipments

Standard reference materials will be disposed of when they met the expiration date. Standards will always be validated with a current standard reference material and will be disposed of when they can no longer meet the + or - 10% ICV guidelines set for laboratory quality assurance.

6. Examples

Refer to attachment #11 for an example of the standards log and its analytical documentation.

VIII. CERTIFICATIONS AND ACCREDITATIONS

The laboratory maintains the following certifications and accreditations:

- American Industrial Hygiene Association
- State of Utah
- State of Arizona

Refer to attachment #12 for copies of the certificates and list of licensed parameters.

IX. DATA REDUCTION, VALIDATION AND REPORTING

All standard curves, quality control information, raw data, and mathematical manipulations of data are recorded in ink in the hard bound laboratory workbook. Any corrections are made with a single strike out line dated and the analyst's initials. Each analyst maintains his or her workbook and files completed workbooks for future reference.

The sample and quality control data is logged into the LIMS data base where final reports are generated. After the reports are generated sample and quality control data are independently reviewed by a second analyst. Below is an outline of the checking procedures used to verify the reportable data. At least 20% of all data entries are checked in this manner. If during the checking process, errors are determined, 100% of the data set will be checked.

- The analyst performing the data processing shall give the data package to an analyst independent of the work for checking. The package shall

X. ANALYTICAL REPORTS AND OTHER DELIVERABLES

The following information is included with each analytical report (see attachment #12).

1. A cover letter referencing the project, pertinent sample information and any sample or analytical abnormalities.

2. Batch and sample number.

3. Date collected.

4. Sample description.

5. Parameter.

6. Value and Units of Concentration.

7. Analyst.

8. Date Analyzed.

9. Holding Times.

10. Method of Analyses.

11. Quality Control Data (provided if requested).

    Each report is reviewed for accuracy of calculations, transcription errors, etc. by a second analyst and approved by the laboratory manager prior to distribution.

It is the policy of ASARCO Inc. to keep all ASARCO Laboratory records and reports on computer file and in hard copy indefinitely. Records for commercial clients, both hard copy and computer files are kept a minimum of ten years.

XI. STANDARD OPERATING PROCEDURE (SOP's)

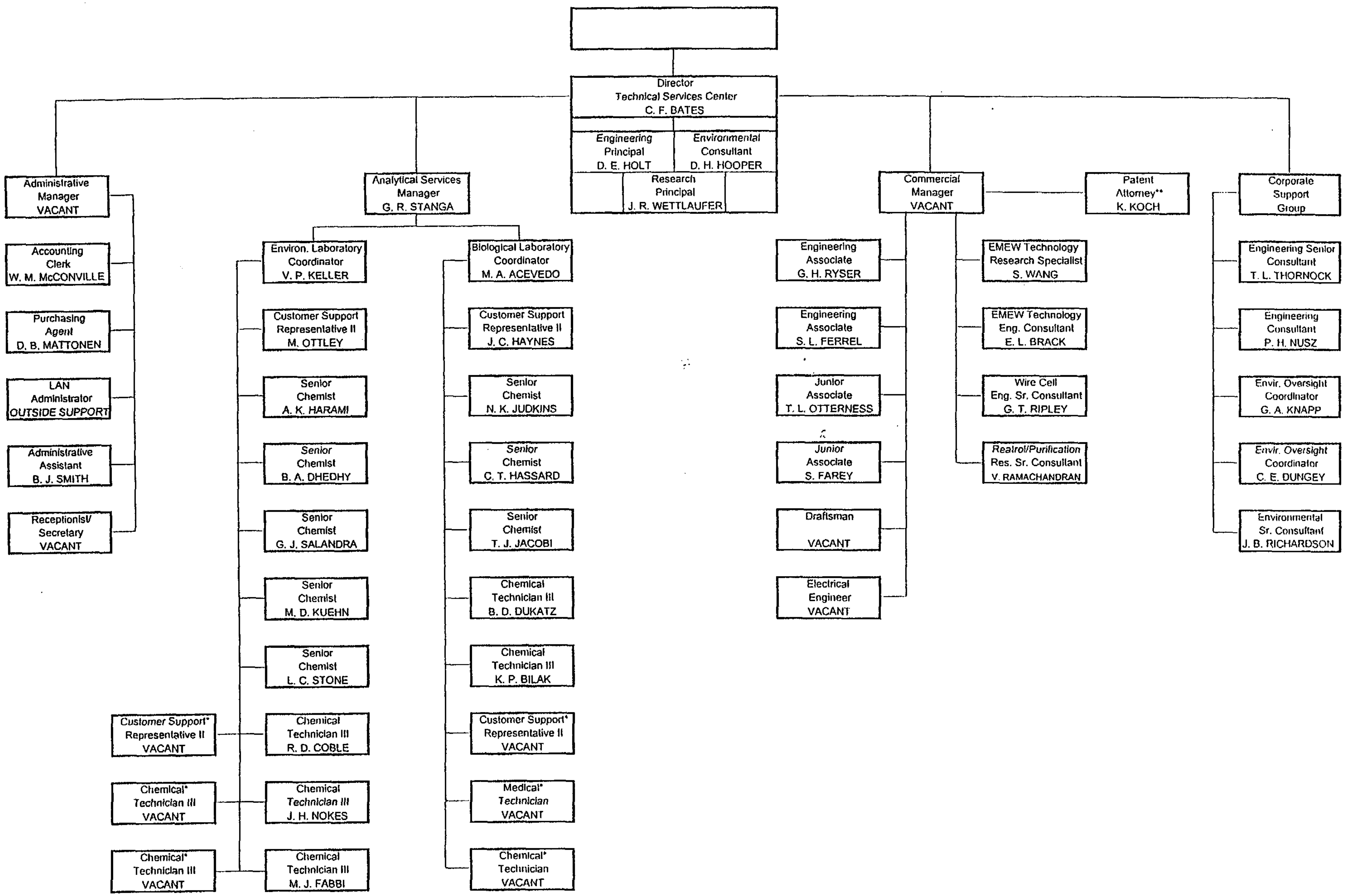
The utilization of SOP's in both the field and laboratory is considered to be a critical component in maintaining a high level of quality and consistency. All field and laboratory personnel are to have ready access to any of the applicable SOP's. SOP's are to be reviewed and dated by the laboratory coordinator and approved and dated by the laboratory manager on an annual basis. The adoption of new SOP's or revision of existing SOP's are performed by the lab coordinator and lab manager. The following table is a list of specific laboratory functions for which a written SOP is available.

XII. Physical Facility

The physical facility is designed to insure that the laboratory staff has suitable space, utilities and equipment to enable them to conduct their tests in a safe and healthful environment and produce quality data. Separate areas have been designated for sample receipt, storage, chemical storage, waste storage, data handling, and incompatible tests. The facility is inspected on a regular basis for health and safety purposes. Both the facility and records are available for inspection by the certifying agency.

ATTACHMENT 1

ORGANIZATION CHART AND EMPLOYEE RESPONSIBILITY



* Needed to go from 160,000 analyses/yr. to 240,000 analyses/yr.
** To be used as needed.

TECHNICAL SERVICES CENTER
ORGANIZATIONAL CHART
January 11, 2000

- Analytical Services Manager
  G. R. STANGA
  - Environ. Laboratory Coordinator
    V. P. KELLER
    - Customer Support Representative II
      M. OTTLEY
    - Senior Chemist
      A. K. HARAMI
    - Senior Chemist
      B. A. DHEDHY
    - Senior Chemist
      G. J. SALANDRA
    - Senior Chemist
      M. D. KUEHN
    - Senior Chemist
      L. C. STONE
    - Chemical Technician III
      R. D. COBLE
    - Chemical Technician III
      J. H. NOKES
    - Chemical Technician III
      M. J. FABBI
  - Biological Laboratory Coordinator
    M. A. ACEVEDO
    - Customer Support Representative II
      J. C. HAYNES
    - Senior Chemist
      N. K. JUDKINS
    - Senior Chemist
      C. T. HASSARD
    - Senior Chemist
      T. J. JACOBI
    - Chemical Technician III
      B. D. DUKATZ
    - Chemical Technician III
      K. P. BILAK

CHEMICAL TECHNICIAN JOB FAMILY

POSITION	DESCRIPTION	GRADE
Chemical Technician I	Entry level position. Under direct supervision performs a variety of simple and routine chemical tests and analyses.	8
Chemical Technician II	Under general supervision, performs a variety of chemical tests and analyses. Typically, requires a minimum of 1 year of Chemical Analyst I experience. Performs method development for laboratory processes.	10
Chemical Technician III	Under limited supervision, performs more complex chemical test and analyses on major projects. Is competent to work in most areas of the laboratory. Uses judgment in the independent evaluation, selection and adaptation of standard methods. Performs method development and evaluation for laboratory processes. Participates in the technical training of new employees. Typically, position requires a minimum of 6 years experience.	12

CHEMICAL TECHNICIAN JOB FAMILY (cont.)

POSITION	DESCRIPTION	GRADE
Senior Chemist	This position represents the highest technical skill. Independently performs most assignments with instruction as to the general results expected. Plans and conducts work requiring mastery of specialized analytical techniques. Supervises and performs method development and evaluation for laboratory processes. Trains and supervises less experienced analysts. Position requires a bachelors degree in Chemistry or related allied field with minimum of 8 years of diverse laboratory work.	14
Laboratory Coordinator	Supervises the daily activities of the Senior Chemists and Chemical Technicians. Coordinates and distributes sample workload. Tracks progress of assigned projects to ensure timely completion. Interacts with plant personnel and commercial clients on a wide variety of issues. Participates in planning lab programs on the basis of specialized knowledge. Organizes and implements laboratory programs. Insures implementation of quality assurance program and oversees proficiency testing programs and corrective action plans. Position requires a bachelors degree in Chemistry or allied related field with a minimum of 10 years of diverse analytical laboratory operations.	16

CUSTOMER SERVICE REPRESENTATIVE JOB FAMILY

POSITION	DESCRIPTION	GRADE
Customer Service Representative I	Entry level - Acts as the secondary customer contact for intercompany and commercial accounts regarding pricing, scheduling and shipping inquiries. Ensures that customers receive the best service possible through processing orders and preparing general correspondence. Strong communication skills is required.	8
Customer Service Representative II	Acts as the customer contact for intercompany and commercial accounts regarding pricing, scheduling and shipping inquiries. Ensures that customers receive the best service possible through processing orders, preparing general correspondence, and coordinating with other functions as required. Strong communication skills and knowledge of laboratory environment required.	11
Senior Customer Service Representative	Primary customer contact for intercompany and commercial accounts regarding pricing, scheduling and shipping inquiries. Ensures that customers receive the best service possible through processing orders, preparing general correspondence, and coordinating with other functions as required. Assists management in planning and coordinating the marketing and advertising of the laboratory. Supervises other Customer Service Representatives. Minimum of five years of customer service work experience in Laboratory environment.	13

MEDICAL TECHNOLOGIST JOB FAMILY

POSITION	DESCRIPTION	GRADE
Medical Technologist I	Entry level position. Under direct supervision, performs simple and routine analysis of biological samples with same day turnaround time. Position requires a bachelors degree in Medical Technology or allied related field.	10
Medical Technologist II	Under minimal supervision, performs more complex analysis and tests of biological samples. Has a working knowledge of instrument operation, maintenance and troubleshooting. Maintains internal quality assurance program. Reviews and enters data into the laboratory information system. Participates in method development and laboratory certification procedures. Position requires a bachelors degree in Medical Technology or allied related field with a minimum of 2 years experience in a clinical laboratory including chemistry, hematology and urinalysis.	12
Senior Medical Technologist	Independently performs most assignments with instruction as to the general results expected. Oversees all activities in the clinical section and is responsible for timely reporting and quality of analyses. Selects, modifies and develops methodologies to enhance analytical capabilities. Trains and supervises less experienced employees. Maintains quality assurance programs. Position requires a bachelors degree in Medical Technology or allied related field with a minimum of 8 years experience in a clinical laboratory including chemistry, hematology and urinalysis.	14

ATTACHMENT 2

SUBMITTAL/CHAIN-OF-CUSTODY FORMS

Technical Services Center

Laboratory Services Request Form
Environmental

PLANT INFORMATION

lant Requesting Service: ____________
erson Requesting Service: ____________
roject Description: ____________
our Project No.: ____________
amples Collected By:

II. REPORT INSTRUCTIONS

Orginal Report To: ____________
Additional Copy Of Report To: ____________
Services Requested Below
are Requested No Later Than: ____________ Date

Please Forward Results by: US Mail ( ) Fed EX ( ) Fax ( ) Other ( )

SEND REQUESTS TO

ASARCO
TSC LABORATORY
3422 South 700 Wes
Salt Lake City, Utah
84119
Your Customer Service
Representative is:
Jodie Haynes

Phone no: (801) 263-52

I. TYPE OF SERVICE REQUESTED:

Please send the following supplies:

( ) Sampling media or containers Please Specify ____________

( ) Laboratory services forms ( ) Other ____________

Please analyze the enclosed samples for:

Sampling ate & Time	Sample I.D./Description/Tag No.	No. of Containers	Analyses Requested	Comments	La (l L

CHAIN OF CUSTODY RECORD

ttest: the Signature Below This Point

atched By:	Date	Time	Courier Company Name:		Shipping Airbill#	Custod
nquished By:	Date	Time	Received By:	Date	Time	Yes
nquished By:	Date	Time	[illegible]			

AEC LABORATORIES

Laboratory Services Request Form

CLIENT INFORMATION

Client Name: ______________________

Client Address: ______________________

____

Client Phone: ______________________

Client Fax: ______________________

SEND REQUEST

AEC LABORT
3422 South 700 W
Salt Lake City, U
84119
Your Customer Servic
Representative is:
Jodie Haynes
Phone # (801)261-142
Fax # (801) 264-9838

ACCOUNT INFORMATION

Account Name: ______________________

Account Address: ______________________

P.O. No: ______________________

REPORT INSTRUCTIONS

Report Results To: ______________________

Report Address: ______________________

Please Forward Results By: US Mail ( ) FedEx ( ) Fax ( ) Other ______

Services Requested below are required no later than ______ (date)

TYPE OF SERVICE REQUESTED

Please analyze the enclosed Industrial Hygiene samples for:

Lab Use Only Lab no	Field Sample No./Description	Date Sample	Air Vol. (Liters)	Time (min.)	ug/filter	ug/m3	Fibers/filter	Analyses Requested

Please analyze the enclosed Environmental samples for:

Lab Use Only Lab no	Field Sample No./Description	Sampling Date & Time	No. of Conts	Analyses Requested

Please send the following supplies:

( ) Laboratory Request Forms ( ) Sampling Media (please specify) ______

( ) Other

COMMENTS

____

3422 South . . West, Salt Lake City, Utah 84119
801-262-7946

CLIENT	SAMPLERS: (Signature)	SAMPLE SITE
PROJECT	SAMPLING CO.	

DATE	TIME	SAMPLE I.D. / DESCRIPTION / TAG NO.	NO. OF CONTAINERS	TYPE	ANALYTES	REMARKS

RELINQUISHED (Signature):	DATE	TIME	RECEIVED (Signature):	RELINQUISHED (Signature):	DATE	TIME	RECEIVED (Signature):
RELINQUISHED (Signature):	DATE	TIME	RECEIVED (Signature):	RELINQUISHED (Signature):	DATE	TIME	RECEIVED (Signature):
[illegible]	DATE	TIME	RECEIVED FOR LAB BY: [illegible]		DATE	TIME	REMARKS

Laboratory Services Request Form
Industrial Hygiene Samples

PLANT INFORMATION

Plant Requesting Services
Person Requesting Service
Project Description
Your Project No.

SEND REQUE
ASARCO
TSC LABORA
3422 South
Salt Lake City
84119
Your Customer Ser
Representative is:
Jodie Haynes
phone no. (801) 262

REPORT INSTRUCTIONS

Original Report To:
Additional Copy of Report To:
Services Requested below are required no later than ____________
date

SAMPLE INFORMATION

Personal Monitor
Employee Name
Employee No.
Employee S.S.N.
Department
Job Classification
Job Code
Respirator Type

Stationary Monitor
Department
Department Code
Area Description

te sampled ____________ Shift ________ Pump/rotameter No.
mpling Conditions
temp (F) barometric pressure (in Hg)

TYPE OF SERVICE REQUESTED

Please analyze the enclosed samples for:

Lab Use Only Lab no.	Filter Cassette No.	Time On	Ball On	Time Off	Ball Off	Total Minutes Sampled	Analyses Requested	To

ase send the following supplies:
) Laboratory Request Forms ( ) Sampling Media (please specify)
) Other

COMMENTS (If applicable check appropriate box and explain below)

] Sample Collection Abnormality (3)
] Ventilation System Malfunction (4)
] Unusual Work Duties (5)
] Time Weighted Average (6)

[ ] Unusual Weather Conitions (7)
[ ] Process Equipment Malfunction, Shutdown, or Curtailment (8)

'antion:

servation Or Activity

ATTACHMENT 3

LOGIN/CHAIN -OF-CUSTODY FORM

LOGIN CHAIN OF CUSTODY REPORT (ln01)
Dec 18 1998, 09:52 am

Login Number: L982521
Account: 7818 East Helena
Project: 3119 Water and Solid Waste

JHW

Laboratory Sample Number			Client Sample Number	Collect Date	Receive Date	PR	Due Date
L982521-1			HDS-E001	14-DEC-98	18-DEC-98		28-DEC-98
HDS Effluent							
Water	S	AS(TR)		Hold:12-JUN-99			1 Bottles
Water	S	CD(TR)		Hold:12-JUN-99			
Water	S	CU(TR)		Hold:12-JUN-99			
Water	S	FE(TR)		Hold:12-JUN-99			
Water	S	HG		Hold:11-JAN-99			
Water	S	PB(TR)		Hold:12-JUN-99			
Water	X	QC DELIVERABLES 10%					
Water	S	SE(TR)					
Water	S	TL(TR)		Hold:12-JUN-99			
Water	S	ZN(TR)	Dom 12/18 ZF	Hold:12-JUN-99			

Signature:

Date: 12/18/98 0100 JF

,40

ATTACHMENT 4

CENTRAL LOGBOOK RECORD

all January due dates are 1999

te	Batch	due	#	Plant	Description	Person	Gr
17.98	2516	R	4	ETX98CON	Clarifier	Rae	S
	2517	R	1	ETX98CON	Plant water Redub 2393	Rae	S
	2518	12.18.98	1	Biowaer	Barneys Canyon	B. Regan	I
	2519	1.5.98	66	Doe Run	Glover BH	R. Gerwicks	I
8.98	2520	11.21.98	3	Murray	1215-1217	Dismukes	M
	2521	12.28.98	1	E. Helena	TDS	J. Cavanaugh	W
	2522	1.6.98	56	Glover	Doe Run SM	R. Gerwicks	I
	2523	1.6.98	9	Biowace	Kennecott Ridgway	D. Hatton	I
	2524	1.6.98	2	Biowace	Kennecott Ridgway	D. Hatton	I
1-98	2526		6	Murray	Filters 1218-1224	Dismukes	M
	2527	12-23.98	1	E. Helena	Cake ICP.	Kranick	P
	2528	1.7.98	1	Flap	Westbury Alloys	J. Phillips	B
	2529	1.7.98	1	Flap	Westbury Alloys	J. Phillips	[illegible]
	2530		1	Leadville	001-A	Seppi	W
	2531	12.23.98	3	Omaha	[illegible] TCLP	Lindstrom	M
	2532	1.7.98	6	IHI	Dallas Yard	S. Steinbacher	I
	2533	12.28.98	12	Amarillo	leached #101	L. McKintosh	S/P
	2534	1.7.98	11	Biowace	Stebbins eng.	stebbins	I
	2535	1.11.98	9	Tacoma	I/E	J. Cross	W
22.98	2536	R	1	ETX98CON	NiSO4 Stock	Furoho	S
	2537	1.5.98	15	Doe Run	chloride 12.13/16/19	R. Keller	A
	2538		43	Tacoma	B/L	J. Cross	W
.98	2539		1	Park City	#100, Q-P, Q-FP	E. Osika	W
	2540		1	Leadville	001-A	Seppi	W
	2541		1	Secor	Asarco		W
	2542		1	E. Helena	TDS	Cavanaugh	W
	2543		1	Hyatsmelt	TDS	Koenig	W
	2544	1.8.98	5	Biowace	Barneys Canyon	Reagan	W
.98	2545	12.28.98	1	Lone Star	B-1 first floor	Payette	I
	2546	12.31.98	1	Lone Star	6th floor	Payette	I
	2547	1.5.99	26	Globe	0791 [illegible]	[illegible]	[illegible]

ATTACHMENT 5

LOGIN CHECKLIST FORM

LOG-IN CHECKLIST

DATE REC'D: ______________________________

SAMPLE ORIGIN ____

BATCH # ______________________________________

SHIPPING CONTAINERS INTACT: Yes __________ No __________

COC SEALS: PRESENT: Yes ____ No ____

TAMPER PROOF: Yes ____ No ____ INTACT: Yes ____ No ____

LOCATION: Left ___ Right ___ Front ___ Back ____

SAMPLE CONTAINERS INTACT: Yes ______ No _______

SAMPLE MATRIX

WATER	SOIL	VEGETATION	MISC./SOLID

CORRECT PRESERVATION		Yes	No	N/A
Metals	(HNO_3)			
Un-Preserved TDS, TSS, Alk., Cl-, F-, Cond., SO4=, S.Grav., NO3, NO2, pH Hardness, Flashpoint, Cr+6	(RAW)			
Nutrients	(H_2SO_4)			
CN-	(NaOH)			
Phenol & P	(H_2SO_4)			
Oil&Grease	(H_2SO_4)			
TEMPERATURE		°C		

COMMENTS: ____

____

____
Signature

ATTACHMENT 6

LAB WORKBOOK RECORD

12/4/98 Sample 982437-1 (TK) digested per SW846-3005
Aliq's 50/50ml, Dup & Spike 25/50ml (SA CCLP#1)
LCS EE ICO-50 .25/50ml & One Acid prep blank (TK)
Sample 982437-1 also digested for mercury
(Hg) analysis. warm digestion ($K_2S_2O_8$/$KMnO_4$) as
per 245.1. Aliquot of 35ml/50ml & 20/50ml for
dup's & Spike (Spike 2ppb SA). One LCS Lab #953722-4
2ml (2ppb) 750ml and one prep blank taken along
12/4/98

Note: TK samples dilution for ICP-MS analysis

12/9/98 Samples 982463-1 TK digested per SW846-3005
Aliq 50/50ml, Dup & Spike 25/50ml (SA Spex Spk #1)
LCS EE ICO-50 .5ml Spex 7mix, .5ml → 50ml & One
Acid Preparation Blank taken along. 982463-1 (Diss)
concentrated 50/25ml & Dup 50/50ml along as samples
Sample 982463-1 also prepared for mercury
analysis warm dig (245.1). Aliquot 35ml, 20ml Dup & Spike
(2ml SA 50ppb = 2ppb in Spike). Lab 953722-4 LCS 2ml (50ppb) and
one prep blank prepared.
12/9/98

12/10/98 (TK) Sample 982463 dilution for ICP-MS analysis

12/18/98 Samples 982521-1 TK dig per SW846 3005
Aliq 10/50, Dup & Spike 25/50ml (SA Spex #1) LCS EE ICO-50
& Spex 7 .5/.25/50ml = 50ppm & One Acid Prep Blank.
Sample 982521-1 also prepared for (Hg) mercury
analysis method 245.1 (warm dig). Aliquots of
35ml, 20ml dup & Spike (SA 2ppb). Lab 953722-4 LCS
of 2ppb & one acid prep blank prepared.
12/18/98

12/8/98 Zn Zinc (Zn) Flame AA, PE 703 as per SOP.

λ 213.9 Burner 180° (direct) .02ppm/[illegible]abs .05ppm/[illegible]abs

.50ppm/.128abs 1.0ppm/.231abs 2.0ppm/.452abs r = [illegible]

* Sample #	conc	ug/ml	correction (ppm)
ICB Blank	—	-.00	
ICV Spex QC 21 ① 1.0ppm		.95	
Spex Cal 1	≤ 1/500	.07-.08	.08 TV
982437-1 (TR)	50/50ml	.68	.68
"	"	(x5 dil) .14-.13	.675
Dup " dup	25/50ml	.33	.66 } 3.0% RPD
Spike " (SHECLP**)	"	.56	1.12 - .68 / .50 SA = 88% R
ICS ElecTCO-50	25ml/50ml	.25	.25 / .25 TV = 100% Rec
PB Prep Blank 12/4	50-250ml	≤.01	<.02
CCV 1.0ppm Std	—	1.01	—
CCB Blank	—	-.01	—

* AZ = Auto Zero every other sample

12/8/98 [signature]

ATTACHMENT 7

METHOD DETECTION LIMITS

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: AL   METHODOLOGY: ICP

INSTRUMENT IDENTIFICATION AND DESCRIPTION: OPTIMA 3000 DV ICP

METHOD of PREPARATION: EPA 3010

METHOD of ANALYSIS: EPA 6010/200.7

MATRIX: WATER

PREPARER: AKH   DATE OF PREPARATION: 06-Dec-00

ANALYST: MDK   DATE OF ANALYSIS: 08-Dec-00

Analyte Conc.: 0.0868   Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.0906	PPM
2	0.0832	PPM
3	0.0799	PPM
4	0.1089	PPM
5	0.0871	PPM
6	0.0767	PPM
7	0.0815	PPM

Mean Analyte Recovery: 0.0868 PPM   2xMDL: 0.0676

Standard Deviation: 0.01075 PPM   Analyte Conc.: $\boxed{0.0868}$

MDL: 0.03379 PPM   10xMDL: 0.3379

Acceptable Analyte Concentration
YES - 2xMDL < Analyte Conc. < 10xMDL

SPIKE SOLUTION EEICQ7

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: AS METHODOLOGY: ICP

INSTRUMENT IDENTIFICATION AND DESCRIPTION: OPTIMA 3000 DV ICP

METHOD of PREPARATION: EPA 3010

METHOD of ANALYSIS: EPA 6010/200.7

MATRIX: WATER

PREPARER: AKH DATE OF PREPARATION: 06-Dec-00

ANALYST: MDK DATE OF ANALYSIS: 06-Dec-00

Analyte Conc.: 0.0500 Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.0510	PPM
2	0.0527	PPM
3	0.0540	PPM
4	0.0553	PPM
5	0.0519	PPM
6	0.0547	PPM
7	0.0559	PPM

Mean Analyte Recovery: 0.0536 PPM 2xMDL: 0.0115

Standard Deviation: 0.00183 PPM Analyte Conc.: 0.0500

MDL: 0.00577 PPM 10xMDL: 0.0577

Acceptable Analyte Concentration
YES - 2xMDL < Analyte Conc. < 10xMDL

SPIKE SOLUTION EEEICQ19

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: AG METHODOLOGY: ICP

INSTRUMENT IDENTIFICATION AND DESCRIPTION: OPTIMA 3000 DV ICP

METHOD of PREPARATION: EPA 3010

METHOD of ANALYSIS: EPA 6010/200.7

MATRIX: WATER

PREPARER: AKH DATE OF PREPARATION: 06-Dec-00

ANALYST: MDK DATE OF ANALYSIS: 08-Dec-00

Analyte Conc.: 0.0100 Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.0094	PPM
2	0.0095	PPM
3	0.0093	PPM
4	0.0091	PPM
5	0.0101	PPM
6	0.0108	PPM
7	0.0090	PPM

Mean Analyte Recovery: 0.0096 PPM 2xMDL: 0.0041

Standard Deviation: 0.00064 PPM Analyte Conc.: 0.0100

MDL: 0.00203 PPM 10xMDL: 0.0203

Acceptable Analyte Concentration
YES - 2xMDL < Analyte Conc. < 10xMDL

SPIKE SOLUTION EEICQ7

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: BE METHODOLOGY: ICP

INSTRUMENT IDENTIFICATION AND DESCRIPTION: OPTIMA 3000 DV ICP

METHOD of PREPARATION: EPA 3010

METHOD of ANALYSIS: EPA 6010/200.7

MATRIX: WATER

PREPARER: AKH DATE OF PREPARATION: 29-Nov-00

ANALYST: MDK DATE OF ANALYSIS: 30-Nov-00

Analyte Conc.: 0.0020 Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.0024	PPM
2	0.0024	PPM
3	0.0025	PPM
4	0.0024	PPM
5	0.0025	PPM
6	0.0025	PPM
7	0.0025	PPM

Mean Analyte Recovery: 0.0025 PPM 2xMDL: 0.0004

Standard Deviation: 0.00006 PPM Analyte Conc.: 0.0020

MDL: 0.0002 PPM 10xMDL: 0.0020

Acceptable Analyte Concentration
YES

SPIKE SOLUTIOI EEEICQ19

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: B   METHODOLOGY: ICP

INSTRUMENT IDENTIFICATION AND DESCRIPTION: OPTIMA 3000 DV ICP

METHOD of PREPARATION: EPA 3010

METHOD of ANALYSIS: EPA 6010/200.7

MATRIX: WATER

PREPARER: AKH   DATE OF PREPARATION: 29-Nov-00

ANALYST: MDK   DATE OF ANALYSIS: 30-Nov-00

Analyte Conc.: 0.1000   Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.1052	PPM
2	0.1120	PPM
3	0.1066	PPM
4	0.1096	PPM
5	0.1016	PPM
6	0.1114	PPM
7	0.1283	PPM

Mean Analyte Recovery: 0.1107 PPM   2xMDL: 0.0540

Standard Deviation: 0.00859 PPM   Analyte Conc.: 0.1000

MDL: 0.02701 PPM   10xMDL: 0.2701

Acceptable Analyte Concentration
YES - 2xMDL < Analyte Conc. < 10xMDL

SPIKE SOLUTIOI EEICQ7

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: Ba METHODOLOGY: ICP

INSTRUMENT IDENTIFICATION AND DESCRIPTION: OPTIMA 3000 DV ICP

METHOD of PREPARATION: EPA 3010

METHOD of ANALYSIS: EPA 6010/200.7

MATRIX: WATER

PREPARER: AKH DATE OF PREPARATION: 29-Nov-00

ANALYST: MDK DATE OF ANALYSIS: 30-Nov-00

Analyte Conc.: 0.0020 Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.0054	PPM
2	0.0054	PPM
3	0.0054	PPM
4	0.0053	PPM
5	0.0058	PPM
6	0.0057	PPM
7	0.0060	PPM

Mean Analyte Recovery: 0.0056 PPM 2xMDL: 0.0017

Standard Deviation: 0.00026 PPM Analyte Conc.: 0.0020

MDL: 0.00083 PPM 10xMDL: 0.0083

Acceptable Analyte Concentration

YES - 2xMDL < Analyte Conc. < 10xMDL

SPIKE SOLUTIONEEICQ7

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: Ca METHODOLOGY: ICP

INSTRUMENT IDENTIFICATION AND DESCRIPTION: OPTIMA 3000 DV ICP

METHOD of PREPARATION: EPA 3010

METHOD of ANALYSIS: EPA 6010/200.7

MATRIX: WATER

PREPARER: AKH DATE OF PREPARATION: 29-Nov-00

ANALYST: MDK DATE OF ANALYSIS: 30-Nov-00

Analyte Conc.: 0.1000 Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.1209	PPM
2	0.1320	PPM
3	0.1239	PPM
4	0.1256	PPM
5	0.1205	PPM
6	0.1132	PPM
7	0.1147	PPM

Mean Analyte Recovery: 0.1215 PPM 2xMDL: 0.0405

Standard Deviation: 0.00645 PPM Analyte Conc.: 0.1000

MDL: 0.02026 PPM 10xMDL: 0.2026

Acceptable Analyte Concentration

YES - 2xMDL < Analyte Conc. < 10xMDL

SPIKE SOLUTIONEEICQ19

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: Cd METHODOLOGY: ICP

INSTRUMENT IDENTIFICATION AND DESCRIPTION: OPTIMA 3000 DV ICP

METHOD of PREPARATION: EPA 3010

METHOD of ANALYSIS: EPA 6010/200.7

MATRIX: WATER

PREPARER: AKH DATE OF PREPARATION: 29-Nov-00

ANALYST: MDK DATE OF ANALYSIS: 30-Nov-00

Analyte Conc.: 0.0020 Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.0020	PPM
2	0.0018	PPM
3	0.0018	PPM
4	0.0017	PPM
5	0.0018	PPM
6	0.0019	PPM
7	0.0017	PPM

Mean Analyte Recovery: 0.0018 PPM 2xMDL: 0.0007

Standard Deviation: 0.00011 PPM Analyte Conc.: 0.0020

MDL: 0.00034 PPM 10xMDL: 0.0034

Acceptable Analyte Concentration
YES - 2xMDL < Analyte Conc. < 10xMDL

SPIKE SOLUTIONEEICQ19

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: Co METHODOLOGY: ICP

INSTRUMENT IDENTIFICATION AND DESCRIPTION: OPTIMA 3000 DV ICP

METHOD of PREPARATION: EPA 3010

METHOD of ANALYSIS: EPA 6010/200.7

MATRIX: WATER

PREPARER: AKH DATE OF PREPARATION: 29-Nov-00

ANALYST: MDK DATE OF ANALYSIS: 30-Nov-00

Analyte Conc.: 0.0020 Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.0010	PPM
2	0.0011	PPM
3	0.0011	PPM
4	0.0010	PPM
5	0.0008	PPM
6	0.0016	PPM
7	0.0013	PPM

Mean Analyte Recovery: 0.0011 PPM 2xMDL: 0.0016

Standard Deviation: 0.00026 PPM Analyte Conc.: 0.0020

MDL: 0.00081 PPM 10xMDL: 0.0081

Acceptable Analyte Concentration
YES - 2xMDL < Analyte Conc. < 10xMDL

SPIKE SOLUTIONEEICQ19

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: Cu METHODOLOGY: ICP

INSTRUMENT IDENTIFICATION AND DESCRIPTION: OPTIMA 3000 DV ICP

METHOD of PREPARATION: EPA 3010

METHOD of ANALYSIS: EPA 6010/200.7

MATRIX: WATER

PREPARER: AKH DATE OF PREPARATION: 29-Nov-00

ANALYST: MDK DATE OF ANALYSIS: 30-Nov-00

Analyte Conc.: 0.0200 Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.0204	PPM
2	0.0194	PPM
3	0.0200	PPM
4	0.0211	PPM
5	0.0190	PPM
6	0.0200	PPM
7	0.0198	PPM

Mean Analyte Recovery: 0.0200 PPM 2xMDL: 0.0043

Standard Deviation: 0.00068 PPM Analyte Conc.: 0.0200

MDL: 0.00213 PPM 10xMDL: 0.0213

Acceptable Analyte Concentration

YES - 2xMDL < Analyte Conc. < 10xMDL

SPIKE SOLUTIONEEICQ19

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: Cr METHODOLOGY: ICP

INSTRUMENT IDENTIFICATION AND DESCRIPTION: OPTIMA 3000 DV ICP

METHOD of PREPARATION: EPA 3010

METHOD of ANALYSIS: EPA 6010/200.7

MATRIX: WATER

PREPARER: AKH DATE OF PREPARATION: 29-Nov-00

ANALYST: MDK DATE OF ANALYSIS: 30-Nov-00

Analyte Conc.: 0.0020 Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.0022	PPM
2	0.0027	PPM
3	0.0026	PPM
4	0.0023	PPM
5	0.0025	PPM
6	0.0029	PPM
7	0.0020	PPM

Mean Analyte Recovery: 0.0025 PPM 2xMDL: 0.0019

Standard Deviation: 0.00031 PPM Analyte Conc.: 0.0020

MDL: 0.00097 PPM 10xMDL: 0.0097

Acceptable Analyte Concentration

YES - 2xMDL < Analyte Conc. < 10xMDL

SPIKE SOLUTIONEEICQ19

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: FE METHODOLOGY: ICP

INSTRUMENT IDENTIFICATION AND DESCRIPTION: OPTIMA 3000 DV ICP

METHOD of PREPARATION: EPA 3010

METHOD of ANALYSIS: EPA 6010/200.7

MATRIX: WATER

PREPARER: AKH DATE OF PREPARATION: 06-Dec-00

ANALYST: MDK DATE OF ANALYSIS: 06-Dec-00

Analyte Conc.: 0.0500 Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.0545	PPM
2	0.0570	PPM
3	0.0680	PPM
4	0.0516	PPM
5	0.0552	PPM
6	0.0491	PPM
7	0.0528	PPM

Mean Analyte Recovery: 0.0554 PPM 2xMDL: 0.0383

Standard Deviation: 0.00610 PPM Analyte Conc.: $\boxed{0.0500}$

MDL: 0.01916 PPM 10xMDL: 0.1916

Acceptable Analyte Concentration

YES - 2xMDL < Analyte Conc. < 10xMDL

SPIKE SOLUTION EEEICQ19

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: MN METHODOLOGY: ICP

INSTRUMENT IDENTIFICATION AND DESCRIPTION: OPTIMA 3000 DV ICP

METHOD of PREPARATION: EPA 3010

METHOD of ANALYSIS: EPA 6010/200.7

MATRIX: WATER

PREPARER: AKH DATE OF PREPARATION: 06-Dec-00

ANALYST: MDK DATE OF ANALYSIS: 06-Dec-00

Analyte Conc.: 0.5000 Analyte Units: PPB (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.3100	PPB
2	0.3200	PPB
3	0.3200	PPB
4	0.2900	PPB
5	0.3700	PPB
6	0.2800	PPB
7	0.3100	PPB

Mean Analyte Recovery: 0.3143 PPB 2xMDL: 0.1809

Standard Deviation: 0.02878 PPB Analyte Conc.: 0.5000

MDL: 0.09047 PPB 10xMDL: 0.9047

Acceptable Analyte Concentration
YES - 2xMDL < Analyte Conc. < 10xMDL

SPIKE SOLUTION EEEICQ19

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: NI METHODOLOGY: ICP

INSTRUMENT IDENTIFICATION AND DESCRIPTION: OPTIMA 3000 DV ICP

METHOD of PREPARATION: EPA 3010

METHOD of ANALYSIS: EPA 6010/200.7

MATRIX: WATER

PREPARER: AKH DATE OF PREPARATION: 06-Dec-00

ANALYST: MDK DATE OF ANALYSIS: 08-Dec-00

Analyte Conc.: 0.0147 Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.0152	PPM
2	0.0146	PPM
3	0.0152	PPM
4	0.0159	PPM
5	0.0157	PPM
6	0.0161	PPM
7	0.0101	PPM

Mean Analyte Recovery: 0.0147 PPM 2xMDL: 0.0131

Standard Deviation: 0.00208 PPM Analyte Conc.: 0.0147

MDL: 0.00655 PPM 10xMDL: 0.0655

Acceptable Analyte Concentration

YES - 2xMDL < Analyte Conc. < 10xMDL

SPIKE SOLUTION EEICQ19

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: K METHODOLOGY: ICP

INSTRUMENT IDENTIFICATION AND DESCRIPTION: OPTIMA 3000 DV ICP

METHOD of PREPARATION: EPA 3010

METHOD of ANALYSIS: EPA 6010/200.7

MATRIX: WATER

PREPARER: AKH DATE OF PREPARATION: 29-Nov-00

ANALYST: MDK DATE OF ANALYSIS: 30-Nov-00

Analyte Conc.: 1.0000 Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.9694	PPM
2	1.0720	PPM
3	1.0650	PPM
4	1.1000	PPM
5	0.8997	PPM
6	1.1000	PPM
7	1.1780	PPM

Mean Analyte Recovery: 1.0549 PPM 2xMDL: 0.5796

Standard Deviation: 0.09221 PPM Analyte Conc.: 1.0000

MDL: 0.28981 PPM 10xMDL: 2.8981

Acceptable Analyte Concentration

YES - 2xMDL < Analyte Conc. < 10xMDL

SPIKE SOLUTIONEEICQ7

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: Mg METHODOLOGY: ICP

INSTRUMENT IDENTIFICATION AND DESCRIPTION: OPTIMA 3000 DV ICP

METHOD of PREPARATION: EPA 3010

METHOD of ANALYSIS: EPA 6010/200.7

MATRIX: WATER

PREPARER: AKH DATE OF PREPARATION: 29-Nov-00

ANALYST: MDK DATE OF ANALYSIS: 30-Nov-00

Analyte Conc.: 0.1000 Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.0985	PPM
2	0.0934	PPM
3	0.0910	PPM
4	0.0998	PPM
5	0.1007	PPM
6	0.0979	PPM
7	0.0977	PPM

Mean Analyte Recovery: 0.0970 PPM 2xMDL: 0.0221

Standard Deviation: 0.00351 PPM Analyte Conc.: 0.1000

MDL: 0.01104 PPM 10xMDL: 0.1104

Acceptable Analyte Concentration

YES - 2xMDL < Analyte Conc. < 10xMDL

SPIKE SOLUTIONEEICQ19

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: Mo METHODOLOGY: ICP

INSTRUMENT IDENTIFICATION AND DESCRIPTION: OPTIMA 3000 DV ICP

METHOD of PREPARATION: EPA 3010

METHOD of ANALYSIS: EPA 6010/200.7

MATRIX: WATER

PREPARER: AKH DATE OF PREPARATION: 29-Nov-00

ANALYST: MDK DATE OF ANALYSIS: 30-Nov-00

Analyte Conc.: 0.0200 Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.0187	PPM
2	0.0177	PPM
3	0.0203	PPM
4	0.0186	PPM
5	0.0189	PPM
6	0.0190	PPM
7	0.0191	PPM

Mean Analyte Recovery: 0.0189 PPM 2xMDL: 0.0049

Standard Deviation: 0.00077 PPM Analyte Conc.: 0.0200

MDL: 0.00243 PPM 10xMDL: 0.0243

Acceptable Analyte Concentration
YES - 2xMDL < Analyte Conc. < 10xMDL

SPIKE SOLUTIONEEICQ19

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: Na METHODOLOGY: ICP

INSTRUMENT IDENTIFICATION AND DESCRIPTION: OPTIMA 3000 DV ICP

METHOD of PREPARATION: EPA 3010

METHOD of ANALYSIS: EPA 6010/200.7

MATRIX: WATER

PREPARER: AKH DATE OF PREPARATION: 29-Nov-00

ANALYST: MDK DATE OF ANALYSIS: 30-Nov-00

Analyte Conc.: 0.1000 Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.1325	PPM
2	0.1242	PPM
3	0.1153	PPM
4	0.1308	PPM
5	0.1143	PPM
6	0.1428	PPM
7	0.1199	PPM

Mean Analyte Recovery: 0.1257 PPM 2xMDL: 0.0649

Standard Deviation: 0.01032 PPM Analyte Conc.: 0.1000

MDL: 0.03243 PPM 10xMDL: 0.3243

Acceptable Analyte Concentration

YES - 2xMDL < Analyte Conc. < 10xMDL

SPIKE SOLUTIONEEICQ7

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: Pb METHODOLOGY: ICP

INSTRUMENT IDENTIFICATION AND DESCRIPTION: OPTIMA 3000 DV ICP

METHOD of PREPARATION: EPA 3010

METHOD of ANALYSIS: EPA 6010/200.7

MATRIX: WATER

PREPARER: AKH DATE OF PREPARATION: 29-Nov-00

ANALYST: MDK DATE OF ANALYSIS: 30-Nov-00

Analyte Conc.: 0.0200 Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.0190	PPM
2	0.0211	PPM
3	0.0210	PPM
4	0.0187	PPM
5	0.0196	PPM
6	0.0163	PPM
7	0.0230	PPM

Mean Analyte Recovery: 0.0198 PPM 2xMDL: 0.0135

Standard Deviation: 0.00214 PPM Analyte Conc.: 0.0200

MDL: 0.00673 PPM 10xMDL: 0.0673

Acceptable Analyte Concentration

YES - 2xMDL < Analyte Conc. < 10xMDL

SPIKE SOLUTIONEEICQ19

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: Se METHODOLOGY: ICP

INSTRUMENT IDENTIFICATION AND DESCRIPTION: OPTIMA 3000 DV ICP

METHOD of PREPARATION: EPA 3010

METHOD of ANALYSIS: EPA 6010/200.7

MATRIX: WATER

PREPARER: AKH DATE OF PREPARATION: 29-Nov-00

ANALYST: MDK DATE OF ANALYSIS: 30-Nov-00

Analyte Conc.: 0.1000 Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.0873	PPM
2	0.0695	PPM
3	0.0736	PPM
4	0.0728	PPM
5	0.0908	PPM
6	0.0838	PPM
7	0.0801	PPM

Mean Analyte Recovery: 0.0797 PPM 2xMDL: 0.0505

Standard Deviation: 0.00803 PPM Analyte Conc.: 0.1000

MDL: 0.02524 PPM 10xMDL: 0.2524

Acceptable Analyte Concentration

YES - 2xMDL < Analyte Conc. < 10xMDL

SPIKE SOLUTIONEEICQ19

ASARCO/AEC LABORATORY

METHOD DETECTION LIMIT DETERMINATION

PARAMETER: Si   METHODOLOGY: ICP

INSTRUMENT IDENTIFICATION AND DESCRIPTION: OPTIMA 3000 DV ICP

METHOD of PREPARATION: EPA 3010

METHOD of ANALYSIS: EPA 6010/200.7

MATRIX: WATER

PREPARER: AKH   DATE OF PREPARATION: 29-Nov-00

ANALYST: MDK   DATE OF ANALYSIS: 30-Nov-00

Analyte Conc.: 0.1000   Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.1266	PPM
2	0.1276	PPM
3	0.1252	PPM
4	0.1251	PPM
5	0.1233	PPM
6	0.1248	PPM
7	0.1353	PPM

Mean Analyte Recovery: 0.1268 PPM   2xMDL: 0.0250

Standard Deviation: 0.00397 PPM   Analyte Conc.: 0.1000

MDL: 0.01248 PPM   10xMDL: 0.1248

Acceptable Analyte Concentration

YES - 2xMDL < Analyte Conc. < 10xMDL

SPIKE SOLUTIONEEICQ7

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: V METHODOLOGY: ICP

INSTRUMENT IDENTIFICATION AND DESCRIPTION: OPTIMA 3000 DV ICP

METHOD of PREPARATION: EPA 3010

METHOD of ANALYSIS: EPA 6010/200.7

MATRIX: WATER

PREPARER: AKH DATE OF PREPARATION: 29-Nov-00

ANALYST: MDK DATE OF ANALYSIS: 30-Nov-00

Analyte Conc.: 0.0200 Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.0188	PPM
2	0.0189	PPM
3	0.0201	PPM
4	0.0196	PPM
5	0.0183	PPM
6	0.0178	PPM
7	0.0188	PPM

Mean Analyte Recovery: 0.0189 PPM 2xMDL: 0.0048

Standard Deviation: 0.00077 PPM Analyte Conc.: 0.0200

MDL: 0.00241 PPM 10xMDL: 0.0241

Acceptable Analyte Concentration

YES - 2xMDL < Analyte Conc. < 10xMDL

SPIKE SOLUTIONEEICQ7

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: SB METHODOLOGY: ICP

INSTRUMENT IDENTIFICATION AND DESCRIPTION: OPTIMA 3000 DV ICP

METHOD of PREPARATION: EPA 3010

METHOD of ANALYSIS: EPA 6010/200.7

MATRIX: WATER

PREPARER: AKH DATE OF PREPARATION: 29-Nov-00

ANALYST: MDK DATE OF ANALYSIS: 30-Nov-00

Analyte Conc.: 0.1000 Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.1076	PPM
2	0.1040	PPM
3	0.1055	PPM
4	0.1139	PPM
5	0.1070	PPM
6	0.1132	PPM
7	0.1156	PPM

Mean Analyte Recovery: 0.1095 PPM 2xMDL: 0.0288

Standard Deviation: 0.00459 PPM Analyte Conc.: $\boxed{0.1000}$

MDL: 0.01442 PPM 10xMDL: 0.1442

Acceptable Analyte Concentration

YES - 2xMDL < Analyte Conc. < 10xMDL

SPIKE SOLUTION EEEICQ19

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: TL METHODOLOGY: ICP

INSTRUMENT IDENTIFICATION AND DESCRIPTION: OPTIMA 3000 DV ICP

METHOD of PREPARATION: EPA 3010

METHOD of ANALYSIS: EPA 6010/200.7

MATRIX: WATER

PREPARER: AKH DATE OF PREPARATION: 06-Dec-00

ANALYST: MDK DATE OF ANALYSIS: 06-Dec-00

Analyte Conc.: 0.0500 Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.0671	PPM
2	0.0590	PPM
3	0.0662	PPM
4	0.0612	PPM
5	0.0612	PPM
6	0.0627	PPM
7	0.0663	PPM

Mean Analyte Recovery: 0.0634 PPM 2xMDL: 0.0199

Standard Deviation: 0.00316 PPM Analyte Conc.: 0.0500

MDL: 0.00994 PPM 10xMDL: 0.0994

Acceptable Analyte Concentration
YES - 2xMDL < Analyte Conc. < 10xMDL

SPIKE SOLUTION EEEICQ19

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: Ag METHODOLOGY: ICP

INSTRUMENT IDENTIFICATION AND DESCRIPTION: OPTIMA 3000 DV ICP

METHOD of PREPARATION: EPA 3050

METHOD of ANALYSIS: EPA6010/3050

MATRIX: SOIL

PREPARER: VPK DATE OF PREPARATION: 07-Dec-00

ANALYST: MDK DATE OF ANALYSIS: 08-Dec-00

Analyte Conc.: 0.0200 Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.0133	PPM
2	0.0172	PPM
3	0.0160	PPM
4	0.0139	PPM
5	0.0192	PPM
6	0.0151	PPM
7	0.0130	PPM

Mean Analyte Recovery: 0.0154 PPM 2xMDL: 0.0143

Standard Deviation: 0.00227 PPM Analyte Conc.: 0.0200

MDL: 0.00713 PPM 10xMDL: 0.0713

Soil MDL Based On One Gram To 50 ml 0.356 ug/g

Acceptable Analyte Concentration

YES - 2xMDL < Analyte Conc. < 10xMDL

SPIKE SOLUTION EEICQ19

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: As METHODOLOGY: ICP

INSTRUMENT IDENTIFICATION AND DESCRIPTION: OPTIMA 3000 DV ICP

METHOD of PREPARATION: EPA 3050

METHOD of ANALYSIS: EPA6010/3050

MATRIX: SOIL

PREPARER: VPK DATE OF PREPARATION: 07-Dec-00

ANALYST: MDK DATE OF ANALYSIS: 08-Dec-00

Analyte Conc.: 0.1000 Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.0910	PPM
2	0.0887	PPM
3	0.0889	PPM
4	0.0938	PPM
5	0.0826	PPM
6	0.0708	PPM
7	0.0830	PPM

Mean Analyte Recovery: 0.0855 PPM 2xMDL: 0.0482

Standard Deviation: 0.00767 PPM Analyte Conc.: 0.1000

MDL: 0.02410 PPM 10xMDL: 0.2410

Soil MDL Based On One Gram To 50 ml 1.205 ug/g

Acceptable Analyte Concentration

YES - 2xMDL < Analyte Conc. < 10xMDL

SPIKE SOLUTION EEICQ19

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: BE METHODOLOGY: ICP

INSTRUMENT IDENTIFICATION AND DESCRIPTION: OPTIMA 3000 DV ICP

METHOD of PREPARATION: EPA 3050

METHOD of ANALYSIS: EPA6010/3050

MATRIX: SOIL

PREPARER: VPK DATE OF PREPARATION: 07-Dec-00

ANALYST: MDK DATE OF ANALYSIS: 08-Dec-00

Analyte Conc.: 0.0040 Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.0041	PPM
2	0.0038	PPM
3	0.0036	PPM
4	0.0036	PPM
5	0.0035	PPM
6	0.0036	PPM
7	0.0036	PPM

Mean Analyte Recovery: 0.0037 PPM 2xMDL: 0.0011

Standard Deviation: 0.00018 PPM Analyte Conc.: 0.0040

MDL: 0.00057 PPM 10xMDL: 0.0057

Soil MDL Based On One Gram To 50 ml 0.029 ug/g

Acceptable Analyte Concentration

YES - 2xMDL < Analyte Conc. < 10xMDL

SPIKE SOLUTION EEICQ19

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: CD METHODOLOGY: ICP

INSTRUMENT IDENTIFICATION AND DESCRIPTION: OPTIMA 3000 DV ICP

METHOD of PREPARATION: EPA 3050

METHOD of ANALYSIS: EPA6010/3050

MATRIX: SOIL

PREPARER: VPK DATE OF PREPARATION: 07-Dec-00

ANALYST: MDK DATE OF ANALYSIS: 08-Dec-00

Analyte Conc.: 0.0040 Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.0034	PPM
2	0.0030	PPM
3	0.0035	PPM
4	0.0034	PPM
5	0.0032	PPM
6	0.0035	PPM
7	0.0034	PPM

Mean Analyte Recovery: 0.0033 PPM 2xMDL: 0.0011

Standard Deviation: 0.00017 PPM Analyte Conc.: 0.0040

MDL: 0.00053 PPM 10xMDL: 0.0053

Soil MDL Based On One Gram To 50 ml 0.026 ug/g

Acceptable Analyte Concentration

YES - 2xMDL < Analyte Conc. < 10xMDL

SPIKE SOLUTION EEICQ19

ASARCO/AEC LABORATORY

METHOD DETECTION LIMIT DETERMINATION

PARAMETER: Cu METHODOLOGY: ICP

INSTRUMENT IDENTIFICATION AND DESCRIPTION: OPTIMA 3000 DV ICP

METHOD of PREPARATION: EPA 3050

METHOD of ANALYSIS: EPA6010/3050

MATRIX: SOIL

PREPARER: VPK DATE OF PREPARATION: 07-Dec-00

ANALYST: MDK DATE OF ANALYSIS: 08-Dec-00

Analyte Conc.: 0.0200 Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.0234	PPM
2	0.0238	PPM
3	0.0256	PPM
4	0.0237	PPM
5	0.0245	PPM
6	0.0247	PPM
7	0.0232	PPM

Mean Analyte Recovery: 0.0241 PPM 2xMDL: 0.0054

Standard Deviation: 0.00086 PPM Analyte Conc.: 0.0200

MDL: 0.00271 PPM 10xMDL: 0.0271

Soil MDL Based On One Gram To 50 ml 0.135 ug/g

Acceptable Analyte Concentration

YES - 2xMDL < Analyte Conc. < 10xMDL

SPIKE SOLUTION EEICQ19

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: Co METHODOLOGY: ICP

INSTRUMENT IDENTIFICATION AND DESCRIPTION: OPTIMA 3000 DV ICP

METHOD of PREPARATION: EPA 3050

METHOD of ANALYSIS: EPA6010/3050

MATRIX: SOIL

PREPARER: VPK DATE OF PREPARATION: 07-Dec-00

ANALYST: MDK DATE OF ANALYSIS: 08-Dec-00

Analyte Conc.: 0.0200 Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.0212	PPM
2	0.0193	PPM
3	0.0195	PPM
4	0.0208	PPM
5	0.0191	PPM
6	0.0197	PPM
7	0.0199	PPM

Mean Analyte Recovery: 0.0199 PPM 2xMDL: 0.0049

Standard Deviation: 0.00078 PPM Analyte Conc.: 0.0200

MDL: 0.00247 PPM 10xMDL: 0.0247

Soil MDL Based On One Gram To 50 ml 0.123 ug/g

Acceptable Analyte Concentration

YES - 2xMDL < Analyte Conc. < 10xMDL

SPIKE SOLUTIOI EEICQ19

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: Cr METHODOLOGY: ICP

INSTRUMENT IDENTIFICATION AND DESCRIPTION: OPTIMA 3000 DV ICP

METHOD of PREPARATION: EPA 3050

METHOD of ANALYSIS: EPA6010/3050

MATRIX: SOIL

PREPARER: VPK DATE OF PREPARATION: 07-Dec-00

ANALYST: MDK DATE OF ANALYSIS: 08-Dec-00

Analyte Conc.: 0.0200 Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.0258	PPM
2	0.0264	PPM
3	0.0276	PPM
4	0.0275	PPM
5	0.0265	PPM
6	0.0269	PPM
7	0.0265	PPM

Mean Analyte Recovery: 0.0268 PPM 2xMDL: 0.0041

Standard Deviation: 0.00065 PPM Analyte Conc.: 0.0200

MDL: 0.00203 PPM 10xMDL: 0.0203

Soil MDL Based On One Gram To 50 ml 0.101 ug/g

Acceptable Analyte Concentration

YES - 2xMDL < Analyte Conc. < 10xMDL

SPIKE SOLUTION EEICQ19

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: Ni METHODOLOGY: ICP

INSTRUMENT IDENTIFICATION AND DESCRIPTION: OPTIMA 3000 DV ICP

METHOD of PREPARATION: EPA 3050

METHOD of ANALYSIS: EPA6010/3050

MATRIX: SOIL

PREPARER: VPK DATE OF PREPARATION: 07-Dec-00

ANALYST: MDK DATE OF ANALYSIS: 08-Dec-00

Analyte Conc.: 0.0200 Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.0211	PPM
2	0.0200	PPM
3	0.0212	PPM
4	0.0216	PPM
5	0.0199	PPM
6	0.0202	PPM
7	0.0200	PPM

Mean Analyte Recovery: 0.0206 PPM 2xMDL: 0.0043

Standard Deviation: 0.00068 PPM Analyte Conc.: 0.0200

MDL: 0.00214 PPM 10xMDL: 0.0214

Soil MDL Based On One Gram To 50 ml 0.107 ug/g

Acceptable Analyte Concentration

YES - 2xMDL < Analyte Conc. < 10xMDL

SPIKE SOLUTION EEICQ19

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: MO   METHODOLOGY: ICP

INSTRUMENT IDENTIFICATION AND DESCRIPTION: OPTIMA 3000 DV ICP

METHOD of PREPARATION: EPA 3050

METHOD of ANALYSIS: EPA6010/3050

MATRIX: SOIL

PREPARER: VPK   DATE OF PREPARATION: 07-Dec-00

ANALYST: MDK   DATE OF ANALYSIS: 08-Dec-00

Analyte Conc.: 0.0040   Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.0039	PPM
2	0.0043	PPM
3	0.0041	PPM
4	0.0035	PPM
5	0.0035	PPM
6	0.0038	PPM
7	0.0048	PPM

Mean Analyte Recovery: 0.0040 PPM   2xMDL: 0.0029

Standard Deviation: 0.00046 PPM   Analyte Conc.: 0.0040

MDL: 0.00146 PPM   10xMDL: 0.0146

Soil MDL Based On One Gram To 50 ml   0.073 ug/g

Acceptable Analyte Concentration

YES - 2xMDL < Analyte Conc. < 10xMDL

SPIKE SOLUTION EEICQ19

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: Pb METHODOLOGY: ICP

INSTRUMENT IDENTIFICATION AND DESCRIPTION: OPTIMA 3000 DV ICP

METHOD of PREPARATION: EPA 3050

METHOD of ANALYSIS: EPA6010/3050

MATRIX: SOIL

PREPARER: VPK DATE OF PREPARATION: 07-Dec-00

ANALYST: MDK DATE OF ANALYSIS: 08-Dec-00

Analyte Conc.: 0.0200 Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.0274	PPM
2	0.0233	PPM
3	0.0231	PPM
4	0.0271	PPM
5	0.0224	PPM
6	0.0210	PPM
7	0.0213	PPM

Mean Analyte Recovery: 0.0237 PPM 2xMDL: 0.0163

Standard Deviation: 0.00259 PPM Analyte Conc.: 0.0200

MDL: 0.00814 PPM 10xMDL: 0.0814

Soil MDL Based On One Gram To 50 ml 0.407 ug/g

Acceptable Analyte Concentration

YES - 2xMDL < Analyte Conc. < 10xMDL

SPIKE SOLUTION EEICQ19

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: SB METHODOLOGY: ICP

INSTRUMENT IDENTIFICATION AND DESCRIPTION: OPTIMA 3000 DV ICP

METHOD of PREPARATION: EPA 3050

METHOD of ANALYSIS: EPA6010/3050

MATRIX: SOIL

PREPARER: VPK DATE OF PREPARATION: 07-Dec-00

ANALYST: MDK DATE OF ANALYSIS: 08-Dec-00

Analyte Conc.: 0.1000 Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.0924	PPM
2	0.0980	PPM
3	0.0861	PPM
4	0.0935	PPM
5	0.0953	PPM
6	0.0950	PPM
7	0.1045	PPM

Mean Analyte Recovery: 0.0950 PPM 2xMDL: 0.0351

Standard Deviation: 0.00559 PPM Analyte Conc.: 0.1000

MDL: 0.01756 PPM 10xMDL: 0.1756

Soil MDL Based On One Gram To 50 ml 0.878 ug/g

Acceptable Analyte Concentration

YES - 2xMDL < Analyte Conc. < 10xMDL

SPIKE SOLUTION EEICQ19

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: Se METHODOLOGY: ICP

INSTRUMENT IDENTIFICATION AND DESCRIPTION: OPTIMA 3000 DV ICP

METHOD of PREPARATION: EPA 3050

METHOD of ANALYSIS: EPA6010/3050

MATRIX: SOIL

PREPARER: VPK DATE OF PREPARATION: 07-Dec-00

ANALYST: MDK DATE OF ANALYSIS: 08-Dec-00

Analyte Conc.: 0.1000 Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.0630	PPM
2	0.0698	PPM
3	0.0501	PPM
4	0.0753	PPM
5	0.0723	PPM
6	0.0731	PPM
7	0.0707	PPM

Mean Analyte Recovery: 0.0677 PPM 2xMDL: 0.0546

Standard Deviation: 0.00868 PPM Analyte Conc.: 0.1000

MDL: 0.02729 PPM 10xMDL: 0.2729

Soil MDL Based On One Gram To 50 ml 1.365 ug/g

Acceptable Analyte Concentration

YES - 2xMDL < Analyte Conc. < 10xMDL

SPIKE SOLUTION EEICQ19

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: TI METHODOLOGY: ICP

INSTRUMENT IDENTIFICATION AND DESCRIPTION: OPTIMA 3000 DV ICP

METHOD of PREPARATION: EPA 3050

METHOD of ANALYSIS: EPA6010/3050

MATRIX: SOIL

PREPARER: VPK DATE OF PREPARATION: 07-Dec-00

ANALYST: MDK DATE OF ANALYSIS: 08-Dec-00

Analyte Conc.: 0.1000 Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.0731	PPM
2	0.0892	PPM
3	0.0749	PPM
4	0.0913	PPM
5	0.0898	PPM
6	0.0722	PPM
7	0.1106	PPM

Mean Analyte Recovery: 0.0859 PPM 2xMDL: 0.0866

Standard Deviation: 0.01377 PPM Analyte Conc.: 0.1000

MDL: 0.04329 PPM 10xMDL: 0.4329

Soil MDL Based On One Gram To 50 ml 2.164 ug/g

Acceptable Analyte Concentration

YES - 2xMDL < Analyte Conc. < 10xMDL

SPIKE SOLUTION EEICQ19

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: V   METHODOLOGY: ICP

INSTRUMENT IDENTIFICATION AND DESCRIPTION: OPTIMA 3000 DV ICP

METHOD of PREPARATION: EPA 3050

METHOD of ANALYSIS: EPA6010/3050

MATRIX: SOIL

PREPARER: VPK   DATE OF PREPARATION: 07-Dec-00

ANALYST: MDK   DATE OF ANALYSIS: 08-Dec-00

Analyte Conc.: 0.0200   Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.0344	PPM
2	0.0362	PPM
3	0.0325	PPM
4	0.0357	PPM
5	0.0342	PPM
6	0.0341	PPM
7	0.0347	PPM

Mean Analyte Recovery: 0.0345 PPM   2xMDL: 0.0074

Standard Deviation: 0.00118 PPM   Analyte Conc.: 0.0200

MDL: 0.00371 PPM   10xMDL: 0.0371

Soil MDL Based On One Gram To 50 ml   0.186 ug/g

Acceptable Analyte Concentration

YES - 2xMDL < Analyte Conc. < 10xMDL

SPIKE SOLUTION EEICQ19

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: Zn METHODOLOGY: ICP

INSTRUMENT IDENTIFICATION AND DESCRIPTION: OPTIMA 3000 DV ICP

METHOD of PREPARATION: EPA 3050

METHOD of ANALYSIS: EPA6010/3050

MATRIX: SOIL

PREPARER: VPK DATE OF PREPARATION: 07-Dec-00

ANALYST: MDK DATE OF ANALYSIS: 08-Dec-00

Analyte Conc.: 0.0200 Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.0596	PPM
2	0.0577	PPM
3	0.0627	PPM
4	0.0645	PPM
5	0.0552	PPM
6	0.0613	PPM
7	0.0614	PPM

Mean Analyte Recovery: 0.0603 PPM 2xMDL: 0.0196

Standard Deviation: 0.00312 PPM Analyte Conc.: 0.0200

MDL: 0.00980 PPM 10xMDL: 0.0980

Soil MDL Based On One Gram To 50 ml 0.490 ug/g

Acceptable Analyte Concentration

YES - 2xMDL < Analyte Conc. < 10xMDL

SPIKE SOLUTIOI EEICQ19

Method Detection Limit Study

40 CFR Part 136, Appendix B

Anal. Method:	EPA 6010	Instrument:	OPTIMA
Prep Method:	EPA 7470	Analyte Conc:	0.15ug/l
Analyte:	HG	Analyst:	ESH
Matrix: TCLP	Sol.#1	Study Date:	12/5/00

Replicates	
#1	0.12
#2	0.16
#3	0.17
#4	0.17
#5	0.14
#6	0.16
#7	0.16

Mean	0.1543
Standard Dev.	0.0181
Student's T Value	3.143
* **MDL**	0.0570 ug/l
RL	0.10ug/l

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: CN- METHODOLOGY: 335.2

INSTRUMENT IDENTIFICATION AND DESCRIPTION:

METHOD of PREPARATION: Distillation

METHOD of ANALYSIS: 335.2

MATRIX: WATER

PREPARER: RDC DATE OF PREPARATION: 29-Nov-00

ANALYST: RDC DATE OF ANALYSIS: 29-Nov-00

Analyte Conc.: 0.0040 Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.0038	PPM
2	0.0032	PPM
3	0.0038	PPM
4	0.0036	PPM
5	0.0038	PPM
6	0.0038	PPM
7	0.0040	PPM

Mean Analyte Recovery: 0.0037 PPM 2xMDL: 0.0016

Standard Deviation: 0.00025 PPM Analyte Conc.: 0.0040

MDL: 0.00080 PPM 10xMDL: 0.0080

Acceptable Analyte Concentration

YES - 2xMDL < Analyte Conc. < 10xMDL

Spike Solution: dilution of stock standard

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: Total Alkalinity METHODOLOGY: ______

INSTRUMENT IDENTIFICATION AND DESCRIPTION: ______

METHOD of PREPARATION: ______

METHOD of ANALYSIS: Total Alkalinity EPA 310.1

MATRIX: Water

PREPARER: RDC DATE OF PREPARATION: N/A

ANALYST: RDC DATE OF ANALYSIS: 04-Dec-00

Analyte Conc.: 1.4400 Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	1.1000	PPM
2	1.6000	PPM
3	1.4000	PPM
4	1.6000	PPM
5	1.4000	PPM
6	1.1000	PPM
7	1.4000	PPM

Mean Analyte Recovery: 1.3714 PPM 2xMDL: 1.2941

Standard Deviation: 0.20587 PPM Analyte Conc.: 1.4400

MDL: 0.64704 PPM 10xMDL: 6.4704

Acceptable Analyte Concentration
YES - 2xMDL < Analyte Conc. < 10xMDL

Spike Solution: ERA 99101

ASARCO/AEC LABORATORY

METHOD DETECTION LIMIT DETERMINATION

PARAMETER: TDS METHODOLOGY: ______

INSTRUMENT IDENTIFICATION AND DESCRIPTION: ______

METHOD of PREPARATION: ______

METHOD of ANALYSIS: 160.1

MATRIX: WATER

PREPARER: ______ DATE OF PREPARATION: ______

ANALYST: RDC DATE OF ANALYSIS: 29-Nov-00

Analyte Conc.: 6.7400 Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	8.4000	PPM
2	9.6000	PPM
3	8.2000	PPM
4	10.8000	PPM
5	11.4000	PPM
6	8.6000	PPM
7	7.6000	PPM

Mean Analyte Recovery: 9.2286 PPM 2xMDL: 8.9320

Standard Deviation: 1.42093 PPM Analyte Conc.: 6.7400

MDL: 4.46599 PPM 10xMDL: 44.6599

Acceptable Analyte Concentration

NO - Analyte Conc. < 2xMDL

Spike Solution:

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: TSS

METHODOLOGY:

INSTRUMENT IDENTIFICATION AND DESCRIPTION:

METHOD of PREPARATION:

METHOD of ANALYSIS: 160.2

MATRIX: WATER

PREPARER: RDC

DATE OF PREPARATION:

ANALYST: RDC

DATE OF ANALYSIS: 29-Nov-00

Analyte Conc.: 7.3800

Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	8.8400	PPM
2	9.4400	PPM
3	9.2000	PPM
4	8.7200	PPM
5	9.0800	PPM
6	8.9200	PPM
7	9.0000	PPM

Mean Analyte Recovery: 9.0286 PPM

2xMDL: 1.5066

Standard Deviation: 0.23968 PPM

Analyte Conc.: 7.3800

MDL: 0.75332 PPM

10xMDL: 7.5332

Acceptable Analyte Concentration

YES - 2xMDL < Analyte Conc. < 10xMDL

Spike Solution: 8076 20/250 DILUTION

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: F-　　METHODOLOGY: EPA 340.2

INSTRUMENT IDENTIFICATION AND DESCRIPTION: ORION EA940

METHOD of PREPARATION:

METHOD of ANALYSIS: 340.2

MATRIX: WATER

PREPARER: EH　　DATE OF PREPARATION:

ANALYST: EH　　DATE OF ANALYSIS: 11-Dec-00

Analyte Conc.: 0.0500　　Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.0522	PPM
2	0.0630	PPM
3	0.0661	PPM
4	0.0645	PPM
5	0.0655	PPM
6	0.0588	PPM
7	0.0612	PPM

Mean Analyte Recovery: 0.0616 PPM　　2xMDL: 0.0306

Standard Deviation: 0.00487 PPM　　Analyte Conc.: 0.0500

MDL: 0.01530 PPM　　10xMDL: 0.1530

Acceptable Analyte Concentration
YES - 2xMDL < Analyte Conc. < 10xMDL

Spike Solution: STOCK STANDARD

Method Detection Limit Study

40 CFR Part 136, Appendix B

Anal. Method: 350.1	Instrument: alpchem M6000
Prep Method:	Analyte Conc: 0.2
Analyte: NH3/N	Analyst: JHN
Matrix: WATER	Study Date: 3/3/00

UNITS: PPM

Replicates	
#1	0.1849
#2	0.1936
#3	0.1904
#4	0.1851
#5	0.1995
#6	0.1954
#7	0.2022

Mean	0.1930
Standard Dev.	0.0067
Student's T Value	3.143
MDL	0.0210 PPM
RL	0.05

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: TKN   METHODOLOGY: EPA 351.2

INSTRUMENT IDENTIFICATION AND DESCRIPTION: ALPCHEM ANION ANALYZER

METHOD of PREPARATION:

METHOD of ANALYSIS: EPA 351.2

MATRIX: WATER

PREPARER: JHN   DATE OF PREPARATION: 27-Nov-00

ANALYST: JHN   DATE OF ANALYSIS: 29-Nov-00

Analyte Conc.: 0.1000   Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.1096	PPM
2	0.1212	PPM
3	0.1150	PPM
4	0.1152	PPM
5	0.1063	PPM
6	0.1020	PPM
7	0.1112	PPM

Mean Analyte Recovery: 0.1115 PPM   2xMDL: 0.0398

Standard Deviation: 0.00634 PPM   Analyte Conc.: 0.1000

MDL: 0.01992 PPM   10xMDL: 0.1992

Acceptable Analyte Concentration

YES - 2xMDL < Analyte Conc. < 10xMDL

Spike Solution: STOCK STANDARD

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: Total Phosphorous METHODOLOGY: 365.1

INSTRUMENT IDENTIFICATION AND DESCRIPTION: Alpchem Anion Analyzer

METHOD of PREPARATION: Tecator Block Digestion

METHOD of ANALYSIS: 365.1

MATRIX: WATER

PREPARER: JHN DATE OF PREPARATION: 06-Nov-00

ANALYST: JHN DATE OF ANALYSIS: 06-Nov-00

Analyte Conc.: 0.0500 Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.0620	PPM
2	0.0560	PPM
3	0.0610	PPM
4	0.0680	PPM
5	0.0630	PPM
6	0.0650	PPM
7	0.0670	PPM

Mean Analyte Recovery: 0.0631 PPM 2xMDL: 0.0255

Standard Deviation: 0.00406 PPM Analyte Conc.: 0.0500

MDL: 0.01276 PPM 10xMDL: 0.1276

Acceptable Analyte Concentration
YES - 2xMDL < Analyte Conc. < 10xMDL

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: Nitrate/Nitrite as N METHODOLOGY: Automated Colorimetric

INSTRUMENT IDENTIFICATION AND DESCRIPTION: Alpchem Anion Analyzer

METHOD of PREPARATION: NA

METHOD of ANALYSIS: 353.2

MATRIX: WATER

PREPARER: NA DATE OF PREPARATION: NA

ANALYST: JHN DATE OF ANALYSIS: 28-Nov-00

Analyte Conc.: 0.1000 Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.1050	PPM
2	0.1170	PPM
3	0.1060	PPM
4	0.1140	PPM
5	0.1180	PPM
6	0.1180	PPM
7	0.1180	PPM

Mean Analyte Recovery: 0.1137 PPM 2xMDL: 0.0364

Standard Deviation: 0.00579 PPM Analyte Conc.: 0.1000

MDL: 0.01821 PPM 10xMDL: 0.1821

Acceptable Analyte Concentration

YES - 2xMDL < Analyte Conc. < 10xMDL

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: BA METHODOLOGY: ICP

INSTRUMENT IDENTIFICATION AND DESCRIPTION: OPTIMA 3000 DV ICP

METHOD of PREPARATION: EPA 3010

METHOD of ANALYSIS: EPA 6010/200.7

MATRIX: WATER (TCLP Sol. #1)

PREPARER: MJF DATE OF PREPARATION: 12-Dec-00

ANALYST: MDK DATE OF ANALYSIS: 12-Dec-00

Analyte Conc.: 0.0500 Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.1051	PPM
2	0.1069	PPM
3	0.1020	PPM
4	0.1020	PPM
5	0.1035	PPM
6	0.1016	PPM
7	0.1011	PPM

Mean Analyte Recovery: 0.1032 PPM 2xMDL: 0.0134

Standard Deviation: 0.00213 PPM Analyte Conc.: 0.0500

MDL: 0.00670 PPM 10xMDL: 0.0670

Acceptable Analyte Concentration
YES - 2xMDL < Analyte Conc. < 10xMDL

SPIKE SOLUTION EEICQ-7

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: CU METHODOLOGY: ICP

INSTRUMENT IDENTIFICATION AND DESCRIPTION: OPTIMA 3000 DV ICP

METHOD of PREPARATION: EPA 3010

METHOD of ANALYSIS: EPA 6010/200.7

MATRIX: WATER (TCLP Sol #1)

PREPARER: MJF DATE OF PREPARATION: 12-Dec-00

ANALYST: MDK DATE OF ANALYSIS: 12-Dec-00

Analyte Conc.: 0.0500 Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.0642	PPM
2	0.0573	PPM
3	0.0577	PPM
4	0.0661	PPM
5	0.0564	PPM
6	0.0614	PPM
7	0.0631	PPM

Mean Analyte Recovery: 0.0609 PPM 2xMDL: 0.0239

Standard Deviation: 0.00380 PPM Analyte Conc.: 0.0500

MDL: 0.01193 PPM 10xMDL: 0.1193

Acceptable Analyte Concentration

YES - 2xMDL < Analyte Conc. < 10xMDL

SPIKE SOLUTION EEICQ19

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: AG METHODOLOGY: ICP

INSTRUMENT IDENTIFICATION AND DESCRIPTION: OPTIMA 3000 DV ICP

METHOD of PREPARATION: EPA 3010

METHOD of ANALYSIS: EPA 6010/200.7

MATRIX: TCLP SOL. #1

PREPARER: MJF DATE OF PREPARATION: 05-Dec-00

ANALYST: MDK DATE OF ANALYSIS: 08-Dec-00

Analyte Conc.: 0.1000 Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.1158	PPM
2	0.1094	PPM
3	0.1439	PPM
4	0.1080	PPM
5	0.1175	PPM
6	0.1090	PPM
7	0.1188	PPM

Mean Analyte Recovery: 0.1175 PPM 2xMDL: 0.0782

Standard Deviation: 0.01245 PPM Analyte Conc.: 0.1000

MDL: 0.03912 PPM 10xMDL: 0.3912

Acceptable Analyte Concentration
YES - 2xMDL < Analyte Conc. < 10xMDL

SPIKE SOLUTIOꞮ EEICQ-7

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: AS METHODOLOGY: ICP

INSTRUMENT IDENTIFICATION AND DESCRIPTION: OPTIMA 3000 DV ICP

METHOD of PREPARATION: EPA 3010

METHOD of ANALYSIS: EPA 6010/200.7

MATRIX: TCLP SOL. #1

PREPARER: MJF DATE OF PREPARATION: 05-Dec-00

ANALYST: MDK DATE OF ANALYSIS: 08-Dec-00

Analyte Conc.: 0.1000 Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.1091	PPM
2	0.0961	PPM
3	0.0957	PPM
4	0.0969	PPM
5	0.0936	PPM
6	0.1083	PPM
7	0.0957	PPM

Mean Analyte Recovery: 0.0993 PPM 2xMDL: 0.0407

Standard Deviation: 0.00647 PPM Analyte Conc.: 0.1000

MDL: 0.02035 PPM 10xMDL: 0.2035

Acceptable Analyte Concentration
YES - 2xMDL < Analyte Conc. < 10xMDL

SPIKE SOLUTION EEICQ-19

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: CD METHODOLOGY: ICP

INSTRUMENT IDENTIFICATION AND DESCRIPTION: OPTIMA 3000 DV ICP

METHOD of PREPARATION: EPA 3010

METHOD of ANALYSIS: EPA 6010/200.7

MATRIX: TCLP SOL. #1

PREPARER: MJF DATE OF PREPARATION: 05-Dec-00

ANALYST: MDK DATE OF ANALYSIS: 08-Dec-00

Analyte Conc.: 0.0200 Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.0196	PPM
2	0.0222	PPM
3	0.0192	PPM
4	0.0187	PPM
5	0.0182	PPM
6	0.0187	PPM
7	0.0186	PPM

Mean Analyte Recovery: 0.0193 PPM 2xMDL: 0.0085

Standard Deviation: 0.00135 PPM Analyte Conc.: 0.0200

MDL: 0.00424 PPM 10xMDL: 0.0424

Acceptable Analyte Concentration
YES - 2xMDL < Analyte Conc. < 10xMDL

SPIKE SOLUTIOI EEICQ19

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: CR METHODOLOGY: ICP

INSTRUMENT IDENTIFICATION AND DESCRIPTION: OPTIMA 3000 DV ICP

METHOD of PREPARATION: EPA 3010

METHOD of ANALYSIS: EPA 6010/200.7

MATRIX: TCLP SOL. #1

PREPARER: MJF DATE OF PREPARATION: 05-Dec-00

ANALYST: MDK DATE OF ANALYSIS: 08-Dec-00

Analyte Conc.: 0.0200 Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.0202	PPM
2	0.0207	PPM
3	0.0214	PPM
4	0.0202	PPM
5	0.0182	PPM
6	0.0187	PPM
7	0.0198	PPM

Mean Analyte Recovery: 0.0199 PPM 2xMDL: 0.0070

Standard Deviation: 0.00111 PPM Analyte Conc.: 0.0200

MDL: 0.00349 PPM 10xMDL: 0.0349

Acceptable Analyte Concentration
YES - 2xMDL < Analyte Conc. < 10xMDL

SPIKE SOLUTION EEICQ-19

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: CR   METHODOLOGY: ICP

INSTRUMENT IDENTIFICATION AND DESCRIPTION: OPTIMA 3000 DV ICP

METHOD of PREPARATION: EPA 3010

METHOD of ANALYSIS: EPA 6010/200.7

MATRIX: TCLP Sol. #1

PREPARER: MJF   DATE OF PREPARATION: 05-Dec-00

ANALYST: MDK   DATE OF ANALYSIS: 08-Dec-00

Analyte Conc.: 0.0200   Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.0202	PPM
2	0.0207	PPM
3	0.0214	PPM
4	0.0202	PPM
5	0.0190	PPM
6	0.0203	PPM
7	0.0198	PPM

Mean Analyte Recovery: 0.0202 PPM   2xMDL: 0.0047

Standard Deviation: 0.00074 PPM   Analyte Conc.: 0.0200

MDL: 0.00233 PPM   10xMDL: 0.0233

Acceptable Analyte Concentration
YES - 2xMDL < Analyte Conc. < 10xMDL

SPIKE SOLUTION EEICQ19

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: FE METHODOLOGY: ICP

INSTRUMENT IDENTIFICATION AND DESCRIPTION: OPTIMA 3000 DV ICP

METHOD of PREPARATION: EPA 3010

METHOD of ANALYSIS: EPA 6010/200.7

MATRIX: TCLP Sol. #1

PREPARER: MJF DATE OF PREPARATION: 05-Dec-00

ANALYST: MDK DATE OF ANALYSIS: 08-Dec-00

Analyte Conc.: 0.1000 Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.1318	PPM
2	0.1421	PPM
3	0.1368	PPM
4	0.1666	PPM
5	0.1385	PPM
6	0.1536	PPM
7	0.1576	PPM

Mean Analyte Recovery: 0.1467 PPM 2xMDL: 0.0800

Standard Deviation: 0.01272 PPM Analyte Conc.: 0.1000

MDL: 0.03998 PPM 10xMDL: 0.3998

Acceptable Analyte Concentration

YES - 2xMDL < Analyte Conc. < 10xMDL

SPIKE SOLUTION EEICQ19

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: NI METHODOLOGY: ICP

INSTRUMENT IDENTIFICATION AND DESCRIPTION: OPTIMA 3000 DV ICP

METHOD of PREPARATION: EPA 3010

METHOD of ANALYSIS: EPA 6010/200.7

MATRIX: TCLP Sol. #1

PREPARER: MJF DATE OF PREPARATION: 05-Dec-00

ANALYST: MDK DATE OF ANALYSIS: 08-Dec-00

Analyte Conc.: 0.0200 Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.0290	PPM
2	0.0281	PPM
3	0.0294	PPM
4	0.0301	PPM
5	0.0302	PPM
6	0.0308	PPM
7	0.0279	PPM

Mean Analyte Recovery: 0.0294 PPM 2xMDL: 0.0069

Standard Deviation: 0.00109 PPM Analyte Conc.: 0.0200

MDL: 0.00344 PPM 10xMDL: 0.0344

Acceptable Analyte Concentration
YES - 2xMDL < Analyte Conc. < 10xMDL

SPIKE SOLUTION EEICQ19

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: PB METHODOLOGY: ICP

INSTRUMENT IDENTIFICATION AND DESCRIPTION: OPTIMA 3000 DV ICP

METHOD of PREPARATION: EPA 3010

METHOD of ANALYSIS: EPA 6010/200.7

MATRIX: TCLP Sol. #1

PREPARER: MJF DATE OF PREPARATION: 05-Dec-00

ANALYST: MDK DATE OF ANALYSIS: 08-Dec-00

Analyte Conc.: 0.1000 Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.0915	PPM
2	0.0868	PPM
3	0.0858	PPM
4	0.0954	PPM
5	0.0936	PPM
6	0.0979	PPM
7	0.1072	PPM

Mean Analyte Recovery: 0.0940 PPM 2xMDL: 0.0457

Standard Deviation: 0.00727 PPM Analyte Conc.: $\boxed{0.1000}$

MDL: 0.02284 PPM 10xMDL: 0.2284

Acceptable Analyte Concentration
YES - 2xMDL < Analyte Conc. < 10xMDL

SPIKE SOLUTION EEICQ19

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: SB METHODOLOGY: ICP

INSTRUMENT IDENTIFICATION AND DESCRIPTION: OPTIMA 3000 DV ICP

METHOD of PREPARATION: EPA 3010

METHOD of ANALYSIS: EPA 6010/200.7

MATRIX: TCLP Sol. #1

PREPARER: MJF DATE OF PREPARATION: 05-Dec-00

ANALYST: MDK DATE OF ANALYSIS: 08-Dec-00

Analyte Conc.: 0.1000 Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.0568	PPM
2	0.0456	PPM
3	0.0430	PPM
4	0.0545	PPM
5	0.0485	PPM
6	0.0492	PPM
7	0.0442	PPM

Mean Analyte Recovery: 0.0488 PPM 2xMDL: 0.0326

Standard Deviation: 0.00519 PPM Analyte Conc.: 0.1000

MDL: 0.01632 PPM 10xMDL: 0.1632

Acceptable Analyte Concentration
YES - 2xMDL < Analyte Conc. < 10xMDL

SPIKE SOLUTION EEICQ-19

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: SE METHODOLOGY: ICP

INSTRUMENT IDENTIFICATION AND DESCRIPTION: OPTIMA 3000 DV ICP

METHOD of PREPARATION: EPA 3010

METHOD of ANALYSIS: EPA 6010/200.7

MATRIX: TCLP Sol. #1

PREPARER: MJF DATE OF PREPARATION: 05-Dec-00

ANALYST: MDK DATE OF ANALYSIS: 08-Dec-00

Analyte Conc.: 0.1000 Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.1068	PPM
2	0.1135	PPM
3	0.1084	PPM
4	0.1051	PPM
5	0.1159	PPM
6	0.1048	PPM
7	0.1053	PPM

Mean Analyte Recovery: 0.1085 PPM 2xMDL: 0.0279

Standard Deviation: 0.00444 PPM Analyte Conc.: 0.1000

MDL: 0.01395 PPM 10xMDL: 0.1395

Acceptable Analyte Concentration
YES - 2xMDL < Analyte Conc. < 10xMDL

SPIKE SOLUTION EEICQ-19

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: TL METHODOLOGY: ICP

INSTRUMENT IDENTIFICATION AND DESCRIPTION: OPTIMA 3000 DV ICP

METHOD of PREPARATION: EPA 3010

METHOD of ANALYSIS: EPA 6010/200.7

MATRIX: TCLP Sol. #1

PREPARER: MJF DATE OF PREPARATION: 05-Dec-00

ANALYST: MDK DATE OF ANALYSIS: 08-Dec-00

Analyte Conc.: 0.1000 Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.1162	PPM
2	0.1326	PPM
3	0.1218	PPM
4	0.1265	PPM
5	0.1209	PPM
6	0.1270	PPM
7	0.1415	PPM

Mean Analyte Recovery: 0.1266 PPM 2xMDL: 0.0527

Standard Deviation: 0.00839 PPM Analyte Conc.: 0.1000

MDL: 0.02635 PPM 10xMDL: 0.2635

Acceptable Analyte Concentration

YES - 2xMDL < Analyte Conc. < 10xMDL

SPIKE SOLUTION EEICQ-19

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: ZN METHODOLOGY: ICP

INSTRUMENT IDENTIFICATION AND DESCRIPTION: OPTIMA 3000 DV ICP

METHOD of PREPARATION: EPA 3010

METHOD of ANALYSIS: EPA 6010/200.7

MATRIX: TCLP Sol. #1

PREPARER: MJF DATE OF PREPARATION: 05-Dec-00

ANALYST: MDK DATE OF ANALYSIS: 08-Dec-00

Analyte Conc.: 0.1000 Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.3250	PPM
2	0.3206	PPM
3	0.3139	PPM
4	0.3255	PPM
5	0.3141	PPM
6	0.3352	PPM
7	0.3425	PPM

Mean Analyte Recovery: 0.3253 PPM 2xMDL: 0.0665

Standard Deviation: 0.01058 PPM Analyte Conc.: 0.1000

MDL: 0.03325 PPM 10xMDL: 0.3325

Acceptable Analyte Concentration
YES - 2xMDL < Analyte Conc. < 10xMDL

SPIKE SOLUTION EEICQ-19

ASARCO/AEC LABORATORY
METHOD DETECTION LIMIT DETERMINATION

PARAMETER: Mo METHODOLOGY: ICP

INSTRUMENT IDENTIFICATION AND DESCRIPTION: OPTIMA 3000 DV ICP

METHOD of PREPARATION: EPA 3010

METHOD of ANALYSIS: EPA 6010/200.7

MATRIX: TCLP Sol. #1

PREPARER: MJF DATE OF PREPARATION: 02-Jan-01

ANALYST: MDK DATE OF ANALYSIS: 02-Jan-01

Analyte Conc.: 0.0020 Analyte Units: PPM (e.g. ppm)

Students T Value: 3.143

Replicate #	Result	Units
1	0.0020	PPM
2	0.0021	PPM
3	0.0020	PPM
4	0.0021	PPM
5	0.0023	PPM
6	0.0020	PPM
7	0.0021	PPM

Mean Analyte Recovery: 0.0021 PPM 2xMDL: 0.0007

Standard Deviation: 0.00011 PPM Analyte Conc.: 0.0020

MDL: 0.00034 PPM 10xMDL: 0.0034

Acceptable Analyte Concentration
YES - 2xMDL < Analyte Conc. < 10xMDL

SPIKE SOLUTION EEICQ19

6020

Method Detection Limit Study

40 CFR Part 136, Appendix B

Anal. Method: EPA 6020

Instrument: Perkin Elmer Elan 6000 ICP-MS

Prep Method: EPA 6020 CLP-M

Analyte Conc: 0.20 ppb

Analyte : Ag Mass 107

Analyst: KPB

Matrix: .5% HCL 1% HCO3

Study Date: 10/1/99

Replicates	
#1	0.13
#2	0.14
#3	0.13
#4	0.12
#5	0.13
#6	0.13
#7	0.13

Mean 0.1300

Standard Dev. 0.005774

Student's T Value 3.143

* MDL 0.0181 PPB

RL 1.0

Method Detection Limit Study

40 CFR Part 136, Appendix B

Anal. Method:	EPA 6020
Prep Method:	EPA 6020 CLP-M
Analyte :	Ag Mass 109
Matrix:	.5% HCL 1% HCO3
Instrument:	Perkin Elmer Elan 6000 ICP-MS
Analyte Conc:	0.20 ppb
Analyst:	KPB
Study Date:	10/1/99

Replicates	
#1	0.13
#2	0.13
#3	0.13
#4	0.12
#5	0.13
#6	0.13
#7	0.13

Mean	0.1286
Standard Dev.	0.00378
Student's T Value	3.143
* MDL	0.0119 PPB
RL	1.0

Method Detection Limit Study

40 CFR Part 136, Appendix B

Anal. Method: EPA 6020

Instrument: Perkin Elmer Elan 6000 ICP-MS

Prep Method: EPA 6020 CLP-M

Analyte Conc: 1.0 PPB

Analyte : Al Mass 27

Analyst: KPB

Matrix: .5% HCL 1% HCO3

Study Date: 10/1/99

Replicates	
#1	1.82
#2	2.23
#3	2.95
#4	2.17
#5	1.1
#6	1.3
#7	1.28

Mean 1.8357

Standard Dev. 0.6641

Student's T Value 3.143

* MDL 2.0873 PPB

RL 5.0

Method Detection Limit Study

40 CFR Part 136, Appendix B

Anal. Method: EPA 6020

Instrument: Perkin Elmer Elan 6000 ICP-MS

Prep Method: EPA 6020 CLP-M

Analyte Conc: 0.40 PPB

Analyte : As Mass 75
(ArCl Corr. Se78)

Analyst: KPB

Matrix: .5% HCL 1% HCO3

Study Date: 10/1/99

Replicates	
#1	0.49
#2	0.45
#3	0.39
#4	0.47
#5	0.4
#6	0.47
#7	0.5

Mean 0.4529

Standard Dev. 0.042706

Student's T Value 3.143

* MDL 0.1342 PPB

RL 3.0

Method Detection Limit Study

40 CFR Part 136, Appendix B

Anal. Method: EPA 6020

Instrument: Perkin Elmer Elan 6000 ICP-MS

Prep Method: EPA 6020 CLP-M

Analyte Conc: 0.40 PPB

Analyte : As Mass 75
(ArCl Corr. Se82)

Analyst: KPB

Matrix: .5% HCL 1% HCO3

Study Date: 10/1/99

Replicates	
#1	0.4
#2	0.4
#3	0.38
#4	0.38
#5	0.32
#6	0.37
#7	0.4

Mean 0.3786

Standard Dev. 0.028536

Student's T Value 3.143

* MDL = 0.0897 PPB

RL 3.0

Method Detection Limit Study

40 CFR Part 136, Appendix B

Anal. Method: EPA 6020

Instrument: Perkin Elmer Elan 6000 ICP-MS

Prep Method: EPA 6020 CLP-M

Analyte Conc: 0.20 PPB

Analyte.: Ba Mass 135

Analyst: KPB

Matrix: .5% HCL 1% HCO3

Study Date: 10/1/99

Replicates	
#1	0.22
#2	0.22
#3	0.26
#4	0.22
#5	0.23
#6	0.22
#7	0.24

Mean 0.2300

Standard Dev. 0.015275

Student's T Value 3.143

* MDL < 0.0480 PPB

RL 5.0

Method Detection Limit Study

40 CFR Part 136, Appendix B

Anal. Method: EPA 6020

Instrument: Perkin Elmer Elan 6000 ICP-MS

Prep Method: EPA 6020 CLP-M

Analyte Conc: 0.20 PPB

Analyte : Ba Mass 137

Analyst: KPB

Matrix: .5% HCL 1% HCO3

Study Date: 10/1/99

Replicates	
#1	0.22
#2	0.23
#3	0.26
#4	0.21
#5	0.23
#6	0.21
#7	0.23

Mean 0.2271

Standard Dev. 0.017043

Student's T Value 3.143

* MDL 0.0536 PPB

RL 5.0

Method Detection Limit Study

40 CFR Part 136, Appendix B

Anal. Method: EPA 6020

Instrument: Perkin Elmer Elan 6000 ICP-MS

Prep Method: EPA 6020 CLP-M

Analyte Conc: 0.20 PPB

Analyte : Be Mass 9

Analyst: KPB

Matrix: .5% HCL 1% HCO3

Study Date: 10/1/99

Replicates	
#1	0.2
#2	0.21
#3	0.21
#4	0.23
#5	0.22
#6	0.19
#7	0.21

Mean 0.2100

Standard Dev. 0.01291

Student's T Value 3.143

* MDL 0.0406 PPB

RL 1.0

Method Detection Limit Study

40 CFR Part 136, Appendix B

Anal. Method: EPA 6020

Instrument: Perkin Elmer Elan 6000 ICP-MS

Prep Method: EPA 6020 CLP-M

Analyte Conc: 0.20 PPB

Analyte : Cd Mass 111

Analyst: KPB

Matrix: .5% HCL 1% HCO3

Study Date: 10/1/99

Replicates	
#1	0.21
#2	0.2
#3	0.21
#4	0.21
#5	0.21
#6	0.2
#7	0.21

Mean 0.2071

Standard Dev. 0.00488

Student's T Value 3.143

* MDL 0.0153 PPB

RL .10

Method Detection Limit Study

40 CFR Part 136, Appendix B

Anal. Method: EPA 6020

Instrument: Perkin Elmer Elan 6000 ICP-MS

Prep Method: EPA 6020 CLP-M

Analyte Conc: 0.20 PPB

Analyte : Cd Mass 114 (MoO corr.)

Analyst: KPB

Matrix: .5% HCL 1% HCO3

Study Date: 10/1/99

Replicates	
#1	0.21
#2	0.21
#3	0.21
#4	0.2
#5	0.21
#6	0.21
#7	0.21

Mean 0.2086

Standard Dev. 0.00378

Student's T Value 3.143

* MDL 0.0119 PPB

RL .10

Method Detection Limit Study

40 CFR Part 136, Appendix B

Anal. Method: EPA 6020

Instrument: Perkin Elmer Elan 6000 ICP-MS

Prep Method: EPA 6020 CLP-M

Analyte Conc: 0.20 PPB

Analyte : Cd Mass 114

Analyst: KPB

Matrix: .5% HCL 1% HCO3

Study Date: 10/1/99

Replicates	
#1	0.21
#2	0.21
#3	0.21
#4	0.2
#5	0.21
#6	0.21
#7	0.21

Mean 0.2086

Standard Dev. 0.00378

Student's T Value 3.143

* MDL : 0.0119 PPB

RL .10

Method Detection Limit Study

40 CFR Part 136, Appendix B

Anal. Method: EPA 6020	Instrument: Perkin Elmer Elan 6000 ICP-MS
Prep Method: EPA 6020 CLP-M	Analyte Conc: 0.40 PPB
Analyte : Co Mass 59	Analyst: KPB
Matrix: .5% HCL 1% HCO3	Study Date: 10/1/99

Replicates	
#1	0.4
#2	0.4
#3	0.4
#4	0.4
#5	0.39
#6	0.4
#7	0.4

Mean	0.3986
Standard Dev.	0.00378
Student's T Value	3.143
* MDL =	0.0119 PPB
RL	1.0

Method Detection Limit Study

40 CFR Part 136, Appendix B

Anal. Method: EPA 6020

Prep Method: EPA 6020 CLP-M

Analyte : Cr Mass 52

Matrix: .5% HCL 1% HCO3

Instrument: Perkin Elmer Elan 6000 ICP-MS

Analyte Conc: 0.40 PPB

Analyst: KPB

Study Date: 10/1/99

Replicates	
#1	0.4
#2	0.36
#3	0.44
#4	0.44
#5	0.41
#6	0.39
#7	0.4

Mean 0.4057

Standard Dev. 0.0282

Student's T Value 3.143

* MDL 0.0886 PPB

RL 1.0

Method Detection Limit Study

40 CFR Part 136, Appendix B

Anal. Method: EPA 6020

Instrument: Perkin Elmer Elan 6000 ICP-MS

Prep Method: EPA 6020 CLP-M

Analyte Conc: 0.20 PPB

Analyte : Cu Mass 63

Analyst: KPB

Matrix: .5% HCL 1% HCO3

Study Date: 10/1/99

Replicates	
#1	0.53
#2	0.5
#3	0.88
#4	0.55
#5	0.27
#6	0.45
#7	0.45

Mean 0.5186

Standard Dev. 0.184068

Student's T Value 3.143

* MDL 0.5785 PPB

RL 3.0

Method Detection Limit Study

40 CFR Part 136, Appendix B

Anal. Method: EPA 6020

Instrument: Perkin Elmer Elan 6000 ICP-MS

Prep Method: EPA 6020 CLP-M

Analyte Conc: 0.20 PPB

Analyte : Cu Mass 65

Analyst: KPB

Matrix: .5% HCL 1% HCO3

Study Date: 10/1/99

Replicates	
#1	0.52
#2	0.51
#3	0.9
#4	0.55
#5	0.27
#6	0.45
#7	0.46

Mean 0.5229

Standard Dev. 0.189887

Student's T Value 3.143

* MDL 0.5968 PPB

RL 3.0

Method Detection Limit Study

40 CFR Part 136, Appendix B

Anal. Method: EPA 6020	Instrument: Perkin Elmer Elan 6000 ICP-MS
Prep Method: EPA 6020 CLP-M	Analyte Conc: 0.20 ppb
Analyte : Mn Mass 55	Analyst: KPB
Matrix: .5% HCL 1% HCO3	Study Date: 10/1/99

Replicates	
#1	0.23
#2	0.24
#3	0.24
#4	0.22
#5	0.26
#6	0.22
#7	0.26

Mean	0.2386
Standard Dev.	0.016762
Student's T Value	3.143
* MDL	0.0527 PPB
RL	1.0

Method Detection Limit Study

40 CFR Part 136, Appendix B

Anal. Method: EPA 6020	Instrument: Perkin Elmer Elan 6000 ICP-MS
Prep Method: EPA 6020 CLP-M	Analyte Conc: 0.20 ppb
Analyte : Mo Mass 97	Analyst: KPB
Matrix: .5% HCL 1% HCO3	Study Date: 10/1/99

Replicates	
#1	0.22
#2	0.21
#3	0.2
#4	0.2
#5	0.22
#6	0.2
#7	0.2

Mean 0.2071

Standard Dev. 0.009512

Student's T Value 3.143

* MDL 0.0299 PPB

RL 1.0

Method Detection Limit Study

40 CFR Part 136, Appendix B

Anal. Method: EPA 6020	Instrument: Perkin Elmer Elan 6000 ICP-MS
Prep Method: EPA 6020 CLP-M	Analyte Conc: 0.20 ppb
Analyte : Mo Mass 98	Analyst: KPB
Matrix: .5% HCL 1% HCO3	Study Date: 10/1/99

Replicates	
#1	0.21
#2	0.2
#3	0.2
#4	0.19
#5	0.21
#6	0.19
#7	0.19

Mean	0.1986
Standard Dev.	0.008997
Student's T Value	3.143
* MDL	0.0283 PPB
RL	1.0

Method Detection Limit Study

40 CFR Part 136, Appendix B

Anal. Method: EPA 6020	Instrument: Perkin Elmer Elan 6000 ICP-MS
Prep Method: EPA 6020 CLP-M	Analyte Conc: 0.20 PPB
Analyte : Ni Mass 60	Analyst: KPB
Matrix: .5% HCL 1% HCO3	Study Date: 10/1/99

Replicates	
#1	0.24
#2	0.22
#3	0.37
#4	0.24
#5	0.27
#6	0.21
#7	0.45

Mean	0.2857
Standard Dev.	0.089974
Student's T Value	3.143
* MDL	0.2828 PPB
RL	1.0

Method Detection Limit Study

40 CFR Part 136, Appendix B

Anal. Method: EPA 6020	Instrument: Perkin Elmer Elan 6000 ICP-MS
Prep Method: EPA 6020 CLP-M	Analyte Conc: 0.20 PPB
Analyte : Ni Mass 60 (CaO Corr.)	Analyst: KPB
Matrix: .5% HCL 1% HCO3	Study Date: 10/1/99

Replicates	
#1	0.24
#2	0.22
#3	0.37
#4	0.24
#5	0.27
#6	0.21
#7	0.45

Mean 0.2857

Standard Dev. 0.089974

Student's T Value 3.143

* MDL 0.2828 PPB

RL 1.0

Method Detection Limit Study

40 CFR Part 136, Appendix B

Anal. Method: EPA 6020

Instrument: Perkin Elmer Elan 6000 ICP-MS

Prep Method: EPA 6020 CLP-M

Analyte Conc: 0.40 PPB

Analyte : Pb Mass 208

Analyst: KPB

Matrix: .5% HCL 1% HCO3

Study Date: 10/1/99

Replicates	
#1	0.5
#2	0.55
#3	0.59
#4	0.5
#5	0.49
#6	0.48
#7	0.54

Mean 0.5214

Standard Dev. 0.039761

Student's T Value 3.143

* MDL 0.1250 PPB

RL 2.0

Method Detection Limit Study

40 CFR Part 136, Appendix B

Anal. Method: EPA 6020	Instrument: Perkin Elmer Elan 6000 ICP-MS
Prep Method: EPA 6020 CLP-M	Analyte Conc: 0.40 PPB
Analyte : Sb Mass 121	Analyst: KPB
Matrix: .5% HCL 1% HCO3	Study Date: 10/1/99

Replicates	
#1	0.54
#2	0.49
#3	0.55
#4	0.52
#5	0.44
#6	0.53
#7	0.47

Mean	0.5057
Standard Dev.	0.040356
Student's T Value	3.143
* MDL	0.1268 PPB
RL	3.0

Method Detection Limit Study

40 CFR Part 136, Appendix B

Anal. Method: EPA 6020	Instrument: Perkin Elmer Elan 6000 ICP-MS
Prep Method: EPA 6020 CLP-M	Analyte Conc: 0.40 PPB
Analyte : Sb Mass 123	Analyst: KPB
Matrix: .5% HCL 1% HCO3	Study Date: 10/1/99

Replicates	
#1	0.55
#2	0.49
#3	0.55
#4	0.52
#5	0.45
#6	0.54
#7	0.47

Mean	0.5100
Standard Dev.	0.040415
Student's T Value	3.143
* MDL :	0.1270 PPB
RL	3.0

Method Detection Limit Study

40 CFR Part 136, Appendix B

Anal. Method: EPA 6020

Instrument: Perkin Elmer Elan 6000 ICP-MS

Prep Method: EPA 6020 CLP-M

Analyte Conc: 0.40 PPB

Analyte : Se Mass 78

Analyst: KPB

Matrix: .5% HCL 1% HCO3

Study Date: 10/1/99

Replicates	
#1	0.66
#2	0.49
#3	0.4
#4	0.62
#5	0.56
#6	0.64
#7	0.68

Mean 0.5786

Standard Dev. 0.10205

Student's T Value 3.143

* MDL 0.3207 PPB

RL 5.0

Method Detection Limit Study

40 CFR Part 136, Appendix B

Anal. Method: EPA 6020

Instrument: Perkin Elmer Elan 6000 ICP-MS

Prep Method: EPA 6020 CLP-M

Analyte Conc: 0.40 PPB

Analyte : Se Mass 82

Analyst: KPB

Matrix: .5% HCL 1% HCO3

Study Date: 10/1/99

Replicates	
#1	0.37
#2	0.32
#3	0.36
#4	0.32
#5	0.28
#6	0.31
#7	0.36

Mean 0.3314

Standard Dev. 0.032878

Student's T Value 3.143

* MDL 0.1033 PPB

RL 5.0

Method Detection Limit Study

40 CFR Part 136, Appendix B

Anal. Method: EPA 6020

Instrument: Perkin Elmer Elan 6000 ICP-MS

Prep Method: EPA 6020 CLP-M

Analyte Conc: 0.20 PPB

Analyte : Ti Mass 49

Analyst: KPB

Matrix: .5% HCL 1% HCO3

Study Date: 10/1/99

Replicates	
#1	0.23
#2	0.22
#3	0.25
#4	0.21
#5	0.2
#6	0.19
#7	0.2

Mean 0.2143

Standard Dev. 0.020702

Student's T Value 3.143

* MDL 0.0651 PPB

RL 5.0

Method Detection Limit Study

40 CFR Part 136, Appendix B

Anal. Method: EPA 6020	Instrument: Perkin Elmer Elan 6000 ICP-MS
Prep Method: EPA 6020 CLP-M	Analyte Conc: 0.20 PPB
Analyte : Tl Mass 205	Analyst: KPB
Matrix: .5% HCL 1% HCO3	Study Date: 10/1/99

Replicates	
#1	0.21
#2	0.2
#3	0.2
#4	0.2
#5	0.2
#6	0.21
#7	0.2

Mean	0.2029
Standard Dev.	0.00488
Student's T Value	3.143
* MDL	0.0153 PPB
RL	1.0

Method Detection Limit Study

40 CFR Part 136, Appendix B

Anal. Method: EPA 6020	Instrument: Perkin Elmer Elan 6000 ICP-MS
Prep Method: EPA 6020 CLP-M	Analyte Conc: 1.0 PPB
Analyte : V Mass 51	Analyst: KPB
Matrix: .5% HCL 1% HCO3	Study Date: 10/1/99

Replicates	
#1	1.12
#2	1.21
#3	1.29
#4	1.36
#5	1.34
#6	1.44
#7	1.77

Mean	1.3614
Standard Dev.	0.208121
Student's T Value	3.143
* MDL	0.6541 PPB
RL	1.0

Method Detection Limit Study

40 CFR Part 136, Appendix B

Anal. Method: EPA 6020

Instrument: Perkin Elmer Elan 6000 ICP-MS

Prep Method: EPA 6020 CLP-M

Analyte Conc: 0.20 PPB

Analyte : Zn Mass 66

Analyst: KPB

Matrix: .5% HCL 1% HCO3

Study Date: 10/1/99

Replicates	
#1	0.77
#2	1.02
#3	1.18
#4	0.85
#5	1.43
#6	0.91
#7	1.08

Mean 1.0343

Standard Dev. 0.223372

Student's T Value 3.143

* MDL 0.7021 PPB

RL 5.0

Method Detection Limit Study

40 CFR Part 136, Appendix B

Anal. Method:	EPA 6020
Prep Method:	EPA 6020 CLP-M
Analyte :	Zn Mass 68
Matrix:	.5% HCL 1% HCO3
Instrument:	Perkin Elmer Elan 6000 ICP-MS
Analyte Conc:	0.20 ppb
Analyst:	KPB
Study Date:	10/1/99

Replicates	
#1	0.8
#2	1.05
#3	1.21
#4	0.91
#5	1.46
#6	0.95
#7	1.13

Mean	1.0729
Standard Dev.	0.219295
Student's T Value	3.143
* MDL	0.6892 PPB
RL	5.0

ATTACHMENT 8

INSTRUMENT MAINTENANCE AGREEMENTS

QUOTATION

PERKIN ELMER

The Perkin-Elmer Corporation
761 Main Avenue
Norwalk, CT 06859-0001
Phone (800) 762-8288, Fax (203) 762-4300
www.perkin-elmer.com

TO
MR GARY STANGA
ASARCO INC
3422 SOUTH 700 WEST
SALT LAKE CITY UT 84119

Quotation No: Q062701
Original Quotation Date: 10/03/1998
Quotation Validity Date: 09/24/1998 to 12/23/1998
Contract Coverage: 01/01/1999 to 12/31/1999
Contract Description: STANDARD PROTECTION

TELEPHONE: 801 263 5251
FAX: 801 264 9838
YOUR REFERENCE:

Prior Customer P.O. No.:

This Agreement is entered into between PERKIN ELMER and the undersigned Customer in consideration of the payments provided for in this Agreement. Subject to the terms and conditions of this Agreement, PERKIN ELMER agrees to perform the services set forth in the coverage of this Agreement on the equipment listed below for the period described.

ITEM NO	QTY	ITEM DESCRIPTION/ COVERAGE DATES	(SERIAL NUMBER)	COVERAGE	GROSS PRICE/MTH	NET PRICE/MTH
010	1	AS60 FURNACE AUTOSAMPLER Begin Date: 01/01/1999 End Date: 12/31/1999	(6935)	P,L,T with OPM	$ 84.00	$ 71.40
020	1	AS60 FURNACE AUTOSAMPLER Begin Date: 01/01/1999 End Date: 12/31/1999	(8424)	P,L,T with OPM	$ 84.00	$ 71.40
030	1	EDLSYSTEM2 VOLTAGE MODULE Begin Date: 01/01/1999 End Date: 12/31/1999	(42078)	P,L,T with OPM	$ 38.00	$ 32.30
040	1	HGA600 FURNACE POWER SUPPLY Begin Date: 01/01/1999 End Date: 12/31/1999	(4599)	P,L,T with OPM	$ 98.00	$ 83.30
050	1	HGA600 FURNACE POWER SUPPLY Begin Date: 01/01/1999 End Date: 12/31/1999	(5526)	P,L,T with OPM	$ 98.00	$ 83.30
060	1	ZEEMAN5100 BGC ACCY ** Begin Date: 01/01/1999 End Date: 12/31/1999	(6235A1)	P,L,T with OPM	$ 103.00	$ 87.55
070	1	ZEEMAN5100 BGC ACCY ** Begin Date: 01/01/1999 End Date: 12/31/1999	(7056)	P,L,T with OPM	$ 103.00	$ 87.55

This quotation is subject to the terms and conditions attached.
NOTE: Customer is responsible for applicable taxes, including sales, use and/or excise tax.
PLEASE SIGN THIS MAINTENANCE AGREEMENT QUOTATION AND RETURN ORIGINAL COPY ALONG WITH YOUR PURCHASE ORDER.

PERKIN ELMER

QUOTATION

The Perkin-Elmer Corporation
761 Main Avenue
Norwalk, CT 06859-0001
Phone: (800) 762-8288, Fax: (203) 762-4300
www.perkin-elmer.com

Quotation No: Q062701
Quotation Date: 10/03/1998
Quotation Validity Date: 09/24/1998 to 12/23/1998

ITEM NO	QTY	ITEM DESCRIPTION/ COVERAGE DATES	(SERIAL NUMBER)	COVERAGE	GROSS PRICE/MTH	NET PRICE/MTH
080	1	5100PC AA INSTRUMENT ** Begin Date: 01/01/1999 End Date: 12/31/1999	(131163)	P,L,T with OPM	$ 272.00	$ 231.20
090	1	5100PC AA INSTRUMENT ** Begin Date: 01/01/1999 End Date: 12/31/1999	(145636)	P,L,T with OPM	$ 272.00	$ 231.20
100	1	703 AA INSTRUMENT Begin Date: 01/01/1999 End Date: 12/31/1999	(117194)	P,L,T with OPM	$ 223.00	$ 189.55
120	1	OPTIMA3000DV ICP INSTRUMENT ** Begin Date: 01/01/1999 End Date: 12/31/1999	(069N7062302)	P,L,T with OPM	$ 868.00	$ 737.80
121	1	ICPSOFTWARE ICP SOFTWARE Begin Date: 01/01/1999 End Date: 12/31/1999	(069N7062302)	P,L,T with OPM	$ 40.00	$ 34.00
130	1	AS91 FLAME AUTOSAMPLER** Begin Date: 01/01/1999 End Date: 12/31/1999	(3610)	P,L,T with OPM	$ 84.00	$ 71.40
140	1	NESLABCHILLER COOLING SYSTEM Begin Date: 01/01/1999 End Date: 12/31/1999	(197127091)	P,L,T with OPM	$ 44.00	$ 37.40
150	1	PERISTALTICPUMP PUMP ASSEMBLY Begin Date: 01/01/1999 End Date: 12/31/1999	(7053007)	P,L,T with OPM	$ 19.00	$ 16.15

Total net price: $ 2,065.50

Net Price includes a volume discount of 15.00% (on items eligible for volume discounts only) plus other discounts that may apply less applicable taxes.

NOTE: Item descriptions above marked with (*) see NOTE 1. Item descriptions above marked with (**) see NOTE 2.

Note 1: This equipment has not been tested to determine Year 2000 compliance or is not Year 2000 compliant. Problems due to Year 2000 non-compliance are excluded from this agreement. Please see the "Exclusions" section in the terms and conditions. To learn about new products that are Year 2000 compliant call us at 800-762-4000 or e-mail us at info @Perkin-Elmer.com.

QUOTATION

PERKIN ELMER

The Perkin-Elmer Corporation
761 Main Avenue
Norwalk, CT 06859-0001
Phone: (800) 762-8288, Fax: (203) 762-4300
www.perkin-elmer.com

Quotation No: Q062701
Quotation Date: 10/03/1998
Quotation Validity Date: 09/24/1998 to 12/23/1998

ITEM NO	QTY	ITEM DESCRIPTION/ COVERAGE DATES	(SERIAL NUMBER)	COVERAGE	GROSS PRICE/MTH	NET PRICE/MTH

Note 2: Please determine Year 2000 compliance using the attached documentation. If the equipment is not Year 2000 compliant, problems due to Year 2000 non-compliance are excluded from this agreement. Please see the "Exclusions" section in the terms and conditions and contact us at 800-762-4000 or e-mail us at info @Perkin-Elmer.com if you require more information. (www.perkin-elmer.com) and refer to the Terms and Conditions.

Zone: Zone 1
Region: INORG RM REGION
Location: USUT01

Contract Notes:

1/99 MERGING OPTIMA3000DV/PUMP/CHILLER/AS91 FOR 12 MONTHS.
12/21 DELETED (1) 703 PER BRIAN.

QUOTATION

PERKIN ELMER

The Perkin-Elmer Corporation
761 Main Avenue
Norwalk, CT 06859-0001
Phone: (800) 762-6288, Fax: (203) 762-4300
www.perkin-elmer.com

Quotation No: Q062701
Quotation Date: 10/03/1998
Quotation Validity Date: 09/24/1998 to 12/23/1998

ITEM NO	QTY	ITEM DESCRIPTION/ COVERAGE DATES	(SERIAL NUMBER)	COVERAGE	GROSS PRICE/MTH	NET PRICE/MTH

Monthly Billing Plan

Planned Invoice date	Monthly Amount
01/01/1999	$ 2,065.50
02/01/1999	$ 2,065.50
03/01/1999	$ 2,065.50
04/01/1999	$ 2,065.50
05/01/1999	$ 2,065.50
06/01/1999	$ 2,065.50
07/01/1999	$ 2,065.50
08/01/1999	$ 2,065.50
09/01/1999	$ 2,065.50
10/01/1999	$ 2,065.50
11/01/1999	$ 2,065.50
12/01/1999	$ 2,065.50

Monthly Billing Plan Total: $24,786.00

Pre-Payment Discount: 5.000 %

Pre-Payment Plan Total: $23,546.40

Bill to/Payer:

ASARCO INC
3422 SOUTH 700 WEST
SALT LAKE CITY UT 84119

Quoted By: Vicki F. Cook

Telephone No: 203-762-6169

Note: Taxes will be applied to your invoice.
We do not have a copy of your tax exemption certificate on file.

Accepted By:

Gary S[illegible]
Signature of authorized person

Gary Stang[illegible] Manager Date 1/4/99
Please print name and title

B099-009
Customer P.O. Number

Payment Schedule: (Please select one only)

Monthly Billing Plan [ ]

Pre-Payment Plan [X]

Legend

1PM Only (no P.L.T) = One Preventive Maintenance Visit only
2PM Only (no P.L.T) = Two Preventive Maintenance Visits Only
3PM Only (no P.L.T) = Three Preventive Maintenance Visits Only
4PM Only (no P.L.T) = Four Preventive Maintenance Visits Only
6PM Only (no P.L.T) = Six Preventive Maintenance Visits Only

P.L.T with 0PM = Emergency service incl. normal Parts, Labor & Travel w/ No PM's
P.L.T with 1PM = Emergency service incl. normal Parts, Labor & Travel w/ One PM
P.L.T with 2PM = Emergency service incl. normal Parts, Labor & Travel w/ Two PM's
P.L.T with 3PM = Emergency service incl. normal Parts, Labor & Travel w/ Three PM's
P.L.T with 5PM = Emergency service incl. normal Parts, Labor & Travel w/ Five PM's
P.L.T with 6PM = Emergency service incl. normal Parts, Labor & Travel w/ Six PM's

PERKIN ELMER

QUOTATION

The Perkin-Elmer Corporation
761 Main Avenue
Norwalk, CT 06859-0001
Phone: (800) 762-8288, Fax: (203) 762-4300
www.perkin-elmer.com

TO

MR GARY STENGA
BIOTRACE LABS
3440 SOUTH 700 WEST
SALT LAKE CITY UT 84119

TELEPHONE: 801 263 5251
FAX: 801 264 9838
YOUR REFERENCE:

Quotation No: Q063363
Original Quotation Date: 10/04/1998
Quotation Validity Date: 11/30/1998 to 02/28/1999
Contract Coverage: 01/01/1999 to 12/31/1999
Contract Description: STD PROT-ELAN 1 PM

Prior Customer P.O. No.:

This Agreement is entered into between PERKIN ELMER and the undersigned Customer in consideration of the payments provided for in this Agreement. Subject to the terms and conditions of this Agreement, PERKIN ELMER agrees to perform the services set forth in the coverage of this Agreement on the equipment listed below for the period described.

ITEM NO	QTY	ITEM DESCRIPTION/ COVERAGE DATES	(SERIAL NUMBER)	COVERAGE	GROSS PRICE/MTH	NET PRICE/MTH
020	1	AS60 FURNACE AUTOSAMPLER Begin Date: 01/01/1999 End Date: 12/31/1999	(8428)	P,L,T with 0PM	$ 84.00	$ 71.40
030	1	AS60 FURNACE AUTOSAMPLER Begin Date: 01/01/1999 End Date: 12/31/1999	(8630)	P,L,T with 0PM	$ 84.00	$ 71.40
050	1	AS91 FLAME AUTOSAMPLER** Begin Date: 01/01/1999 End Date: 12/31/1999	(3263)	P,L,T with 1PM	$ 84.00	$ 71.40
070	1	EDLSYSTEM2 VOLTAGE MODULE Begin Date: 01/01/1999 End Date: 12/31/1999	(420285)	P,L,T with 0PM	$ 38.00	$ 32.30
080	1	ELAN6000 MAS INSTRUMENT ** Begin Date: 01/01/1999 End Date: 12/31/1999	(91950860)	P,L,T with 1PM	$ 1,544.00	$ 1,312.40
110	1	HGA600 FURNACE POWER SUPPLY Begin Date: 01/01/1999 End Date: 12/31/1999	(5602)	P,L,T with 0PM	$ 98.00	$ 83.30
120	1	HGA600 FURNACE POWER SUPPLY Begin Date: 01/01/1999 End Date: 12/31/1999	(5622)	P,L,T with 0PM	$ 98.00	$ 83.30

This quotation is subject to the terms and conditions attached.
NOTE: Customer is responsible for applicable taxes, including sales, use and/or excise tax.
PLEASE SIGN THIS MAINTENANCE AGREEMENT QUOTATION AND RETURN ORIGINAL COPY ALONG WITH YOUR PURCHASE ORDER.

QUOTATION

PERKIN ELMER

The Perkin-Elmer Corporation
761 Main Avenue
Norwalk, CT 06859-0001
Phone: (800) 762-8288, Fax: (203) 762-4300
www.perkin-elmer.com

Quotation No: Q063363
Quotation Date: 10/04/1998
Quotation Validity Date: 11/30/1998 to 02/28/1999

ITEM NO	QTY	ITEM DESCRIPTION/ COVERAGE DATES	(SERIAL NUMBER)	COVERAGE	GROSS PRICE/MTH	NET PRICE/MTH
130	1	NESLABCHILLER COOLING SYSTEM Begin Date: 01/01/1999 End Date: 12/31/1999	(695145140)	P,L,T with OPM	$ 44.00	$ 37.40
150	1	ZEEMAN5100 BGC ACCY ** Begin Date: 01/01/1999 End Date: 12/31/1999	(7067)	P,L,T with OPM	$ 103.00	$ 87.55
160	1	ZEEMAN5100 BGC ACCY ** Begin Date: 01/01/1999 End Date: 12/31/1999	(7068)	P,L,T with OPM	$ 103.00	$ 87.55
170	1	3110 AA INSTRUMENT ** Begin Date: 01/01/1999 End Date: 12/31/1999	(311N3042304)	P,L,T with OPM	$ 140.00	$ 119.00
180	1	5000 AA INSTRUMENT Begin Date: 01/01/1999 End Date: 12/31/1999	(119979)	P,L,T with OPM	$ 333.00	$ 283.05
190	1	5100 AA INSTRUMENT ** Begin Date: 01/01/1999 End Date: 12/31/1999	(145322)	P,L,T with OPM	$ 272.00	$ 231.20
200	1	5100PC AA INSTRUMENT ** Begin Date: 01/01/1999 End Date: 12/31/1999	(149621)	P,L,T with OPM	$ 272.00	$ 231.20
					Total net price:	$ 2,802.45

Net Price includes a volume discount of 15.00% (on items eligible for volume discounts only) plus other discounts that may apply less applicable taxes.

NOTE: Item descriptions above marked with (*) see NOTE 1. Item descriptions above marked with (**) see NOTE 2.

Note 1: This equipment has not been tested to determine Year 2000 compliance or is not Year 2000 compliant. Problems due to Year 2000 non-compliance are excluded from this agreement. Please see the "Exclusions" section in the terms and conditions. To learn about new products that are Year 2000 compliant call us at 800-762-4000 or e-mail us at info @Perkin-Elmer.com.

Note 2: Please determine Year 2000 compliance using the attached documentation. If the equipment is not Year 2000 compliant, problems due to Year 2000 non-compliance are excluded from this agreement. Please see the "Exclusions" section in the terms and conditions and contact us at 800-762-4000 or e-mail us at info @Perkin-Elmer.com if you require more information. (www.perkin-elmer.com) and refer to the Terms and Conditions.

PERKIN ELMER

The Perkin-Elmer Corporation
761 Main Avenue
Norwalk, CT 06859-0001
Phone: (800) 762-8288, Fax: (203) 762-4300
www.perkin-elmer.com

QUOTATION

Quotation No: Q063363
Quotation Date: 10/04/1998
Quotation Validity Date: 11/30/1998 to 02/28/1999

ITEM NO	QTY	ITEM DESCRIPTION/ COVERAGE DATES	(SERIAL NUMBER)	COVERAGE	GROSS PRICE/MTH	NET PRICE/MTH
		Zone: Zone 1 Region: INORG RM REGION Location: USUT01				

Contract Notes:

12/21 DELETED 6 ITEMS PER BRIAN: AS40,AS90,DEC,FIAS200,HGA500,ZEEMAN5000

PERKIN ELMER

QUOTATION

The Perkin-Elmer Corporation
761 Main Avenue
Norwalk, CT 06859-0001
Phone: (800) 762-8288, Fax: (203) 762-4300
www.perkin-elmer.com

Quotation No: Q063363
Quotation Date: 10/04/1998
Quotation Validity Date: 11/30/1998 to 02/28/1999

ITEM NO	QTY	ITEM DESCRIPTION/ COVERAGE DATES	(SERIAL NUMBER)	COVERAGE	GROSS PRICE/MTH	NET PRICE/MTH

Monthly Billing Plan

Planned Invoice date	Monthly Amount
01/01/1999	$ 2,802.45
02/01/1999	$ 2,802.45
03/01/1999	$ 2,802.45
04/01/1999	$ 2,802.45
05/01/1999	$ 2,802.45
06/01/1999	$ 2,802.45
07/01/1999	$ 2,802.45
08/01/1999	$ 2,802.45
09/01/1999	$ 2,802.45
10/01/1999	$ 2,802.45
11/01/1999	$ 2,802.45
12/01/1999	$ 2,802.45

Monthly Billing Plan Total: $33,629.40

Pre-Payment Discount: 5.000 %

Pre-Payment Plan Total: $31,947.72

Bill to/Payer:

BIOTRACE LABS
3440 SOUTH 700 WEST
SALT LAKE CITY UT 84119

Quoted By: Vicki F. Cook

Telephone No: 203-762-6169

Note: Taxes will be applied to your invoice.
We do not have a copy of your tax exemption certificate on file.

Accepted By:

Gary Stanga

Signature of authorized person

Gary Stanga Manager 1/4/99

Please print name and title Date

B099-008

Customer P.O. Number

Payment Schedule: (Please select one only)

Monthly Billing Plan [ ]

Pre-Payment Plan [X]

Legend

1PM Only (no P.L.T) = One Preventive Maintenance Visit only
2PM Only (no P.L.T) = Two Preventive Maintenance Visits Only
3PM Only (no P.L.T) = Three Preventive Maintenance Visits Only
4PM Only (no P.L.T) = Four Preventive Maintenance Visits Only
6PM Only (no P.L.T) = Six Preventive Maintenance Visits Only

P.L.T with 0PM = Emergency service incl. normal Parts, Labor & Travel w/ No PM's
P.L.T with 1PM = Emergency service incl. normal Parts, Labor & Travel w/ One PM
P.L.T with 2PM = Emergency service incl. normal Parts, Labor & Travel w/ Two PM's
P.L.T with 3PM = Emergency service incl. normal Parts, Labor & Travel w/ Three PM's
P.L.T with 5PM = Emergency service incl. normal Parts, Labor & Travel w/ Five PM's
P.L.T with 6PM = Emergency service incl. normal Parts, Labor & Travel w/ Six PM's

spectrace
A Thermo Instruments Company

Service Contract Quotation

Quotation For	Status RENEWAL	Type FULL SERVICE	Contract Type

Quote Valid Until:

RENEWAL OFFER EXPIRES: 4/01/99

Dates of Coverage for Service Contract

Period Covered By Agreement
1/01/99 To 12/31/99

Ship To Address	Bill To Address
ASARCO INC. TECHNICAL SERVICE CENTER 3422 SOUTH 700 WEST SALT LAKE CITY UT 84119 8012622459	ASARCO INC. TECHNICAL SERVICE CENTER 3422 SOUTH 700 WEST SALT LAKE CITY UT 84119 8012622459 GARY STANGA

PAGE 1 OF 1	Quote Reference Number Agreement #: 90000219 7	Total Amount 8411.00

Coverage Includes all items listed below

EQUIPMENT / SERIAL NUMBER	INSTALLED / MODEL NUMBER	AMOUNT
6000 SYSTEM 26995-001	6/04/91 6000/50	6710.00
BD., DATA MEMORY (AT CLONE)	AT CLONE	0.00
PUMP, VACUUM ONLY		0.00
TUBE 50KV .35MA RH XRAY (4K,5K,6K		1701.00
DETECTOR, ECD AL		0.00

Coverage Excludes:

Computer Systems
X-ray tubes

Except where noted

Terms are NET 30

One PM Visit is included with each FULL SERVICE Agreement. PM visits must be scheduled prior to contract expiration

Quotation totals:

SUBTOTAL	8411.00
TAX	0.00
TOTAL	8411.00

Acceptance of Agreement:

Sign Gary S[illegible]

Title Lab Manager

Date 12/10/98

PO#:

ACKLNOWLEGEMENT OF RECEIPT OF PO# FOR CONTRACT RENEWALL

Notes:

spectrace
INSTRUMENTS
A Thermo Instrument Controls, Inc. company

FULL SERVICE
CONTRACT AGREEMENT

I. GENERAL INFORMATION

A Spectrace Instruments service agreement satisfies an ever increasing need for prompt efficient service after the standard warranty for the system has expired.

A FULL SERVICE AGREEMENT covers the following items:

A. All parts costs;
B. All freight costs;
C. All labor costs for travel time and on-site time;
D. All incurred costs such as round trip air fare, rental car, lodging, meals, parking, baggage handling, personal car use, etc.;
E. Preventive Maintenance.

A service agreement allows the customer to accurately determine future repair costs for budgetary purposes, and know that service problems will be handled on a priority basis.

II. EQUIPMENT COVERED

The equipment covered under this Agreement is limited to the system components itemized on the service contract proposal.

III. REPAIR METHODS

If it is determined, after discussion of a problem with a Spectrace Instruments Service Engineer, that the problem is most likely confined to a particular board or module, the Service Engineer may send a replacement/loaner board or module to the customer to install in the system to correct the problem. If this initial attempt does not cure the problem, on-site service will be promptly accomplished. Equipment covered under this Agreement will normally be repaired at the customers site within two (2) working days after determining an on-site visit is required by Spectrace Instruments.

In certain situations it may be necessary to return system components to the Spectrace Instruments factory for repair if on-site service is not practical. In these isolated instances, all shipping costs will be paid by Spectrace Instruments. The customer must contact Spectrace Instruments Service Department for a Return Authorization number and method of shipment when the system must be returned. Spectrace Instruments will make a reasonable attempt to provide loaner equipment in these instances.

Spectrace Instruments, 1275 Hammerwood Ave., Sunnyvale, CA 94089 , 408-744-1414. FAX 408-744-1313

IV. RESPONSIBILITY AND EXCLUSIONS

SPECTRACE INSTRUMENTS EXCLUDES OR RESERVES THE RIGHT TO DETERMINE THE FOLLOWING AREAS OF RESPONSIBILITY.

This service Agreement does not cover, and Spectrace Instruments is not responsible for the following:

A. Repair of instrument damage, replacement of parts or increase in service time caused by-

   1. failure to continually maintain a suitable environment as prescribed by Spectrace;
   2. accident, disaster, transportation, vandalism, neglect, misuse or abuse;
   3. another product or device not under Spectrace warranty or a Spectrace agreement ;
   4. service of the instrument by other than Spectrace;
   5. a non-Spectrace modification;
   6. power line failures, fluctuations and/or transients;
   7. failure to maintain the SiLi detector at operating temperature, either by loss of liquid nitrogen, or loss of A/C for ECD systems;
   8. failure to maintain power or restore power to the ion pump in an ECD system;
   9. failure to operate the instrument as prescribed by operating and technical documentation;

B. Any costs, service or repairs required due to damage or breakage of the detector window;

C. Any X-ray tube costs, service , or repairs due to either damage to its window or decreased emission resulting from normal use;

D. Service and parts for cathode ray tube repair when due to loss of display intensity, age, or tube breakage;

E. Service or repairs required because of rearrangement or relocation. Spectrace Instruments service personnel will provide telephone assistance at no charge when help is needed concerning cabling of the system, special requirements of problems, etc.;

F. Delays caused by suppliers in providing materials or service, strikes, delays in transportation, interruption in business by either party or other causes beyond the control of Spectrace Instruments;

G. Any costs incurred by Spectrace Instruments to determine liability;

H. Losses incurred by the customer due to instrument downtime;

I. Consumable items -- paper for printers and plotters, ink ribbons, cassettes, diskettes, window material, etc.;

J. Painting or refinishing instruments or furnishing material thereof;

K. Electrical work done external to the instrument;

L. Installation, maintenance, or removal of alterations or attachments to an instrument or any service which is impractical for Spectrace to render because of such alterations or attachments;

M. Loss of files, data, or programs contained in storage media covered by this Agreement.

Service, repair, parts and freight charges associated with Section IV items A-M will be Billable at Spectrace Instruments service rates in effect at that time.

Spectrace Instruments, 1275 Hammerwood Ave., Sunnyvale, CA 94089 , 408-744-1414. FAX 408-744-1313

V. CUSTOMER ASSISTANCE

A reasonable effort on the part of the customer is expected when problems are encountered. This includes over the phone discussion of the problem, assistance in performing diagnostics' programs, replacement of boards/modules that have been shipped to the customer, simple voltage measurements of the DC power supplies, etc. all of which will be done under the guidance of a qualified service engineer. The customer has the right to refuse to help at the time but runs the risk of delaying repair time beyond normal and reasonable time.

Highly technical support or major assistance will not be expected or requested of the customer.

VI. SERVICE HOURS

Contact with our Service Department will be available between the hours of 8:00 AM and 5:00 PM, Monday through Friday, excluding Spectrace Instruments holidays.

VII. PREVENTIVE MAINTENANCE/ EMERGENCY SERVICE

Spectrace will provide at the customers site one (1) scheduled Preventive Maintenance (PM) visit during the coverage period, and an unlimited number of emergency visits, excluding visits as described in section IV. The visits will include all labor, parts and materials Spectrace deems necessary to maintain the equipment in good operating condition(except those parts specifically excluded from this contract).

VIII. RENEWAL

This Agreement may be renewed for additional successive yearly periods by mutual consent at the rates currently in effect at time of renewal.

IX. PAYMENT TERMS

Standard terms are Net 30 days after date of invoice.

X. MULTIPLE SYSTEM DISCOUNT

Multiple system discounts are available when all systems are at the same location and covered under the same service agreement by the same purchase order number.

XI. MISCELLANEOUS

The customer signed acceptance and purchase order will constitute an offer in accordance with the terms hereof and such offer, upon endorsement of our acceptance by way of return invoice will constitute the contractual agreement.

Unless otherwise stated in writing, Spectrace Instruments' quoted prices do not include sales, use, excise or similar taxes. Consequently, the amount of any present or future tax shall be paid by the customer, or in lieu thereof, customer shall provide Spectrace Instruments with a tax exemption certificate.

Spectrace Instruments, 1275 Hammerwood Ave., Sunnyvale, CA 94089 , 408-744-1414. FAX 408-744-1313

Spectrace does not assure uninterrupted or error-free operation of the instrument/s. Spectrace is not responsible for failure to fulfill its obligations under this Agreement due to causes beyond its control.

XII. TERMS AND CONDITIONS

Any terms and/or conditions of the customer's order that are inconsistent with the terms and/or conditions of our Agreement shall not be binding on Spectrace Instruments and shall not be considered applicable to any sales made pursuant to this quotation. No waiver, alteration or modification of any of the provisions of this Agreement shall be binding unless in writing and signed by the Spectrace Instruments Service Manager.

You and Spectrace agree that the complete and exclusive statement of the agreement relating to the subject shall consist of the Agreement and its applicable Amendments and Supplements, including those effective in the future. This statement of the agreements supersedes all proposals or other agreements, oral or written, and all other communications between the parties relating to this subject. This Agreement may not be reassigned without the consent of Spectrace Instruments.

Neither party may bring an action, regardless of form, arising out of this Agreement more than 1 year after the cause of action has arisen. Spectrace may not bring an action for nonpayment more than two years after the date the last payment was due.

XIII. CUSTOMER RESPONSIBILITIES

Customer agrees to provide a suitable environment for the instrument as specified by Spectrace. Customer agrees to operate the instrument in accordance with Spectrace operating procedures and safety precautions. Customer will provide Spectrace full, free, and safe access to the instrument in the event a service call is necessary. Customer agrees to inform Spectrace of changes in location of the instrument prior to movement of the instrument.

Customer agrees to backup, remove, protect, and restore, as applicable, programs, files, data, and removable storage media contained in failing computers covered under this Agreement.

Customer agrees to remove all features, parts, options, alterations and attachments that are not subject to this Agreement before presenting a failed component for exchange or repair.

Parts sent to the customer for exchange are to be returned to Spectrace Instruments within 10 working days after the repair of the instrument. Spectrace Instruments will pay for the return shipping charges. Parts are to be returned via Federal Express Economy unless otherwise directed by a Spectrace Instruments representative. Failure to return the parts within the specified period may be cause for cancellation of this Agreement. The replacement cost of any part lost due to the customers negligence will be paid by the customer.

XIV. CANCELLATION

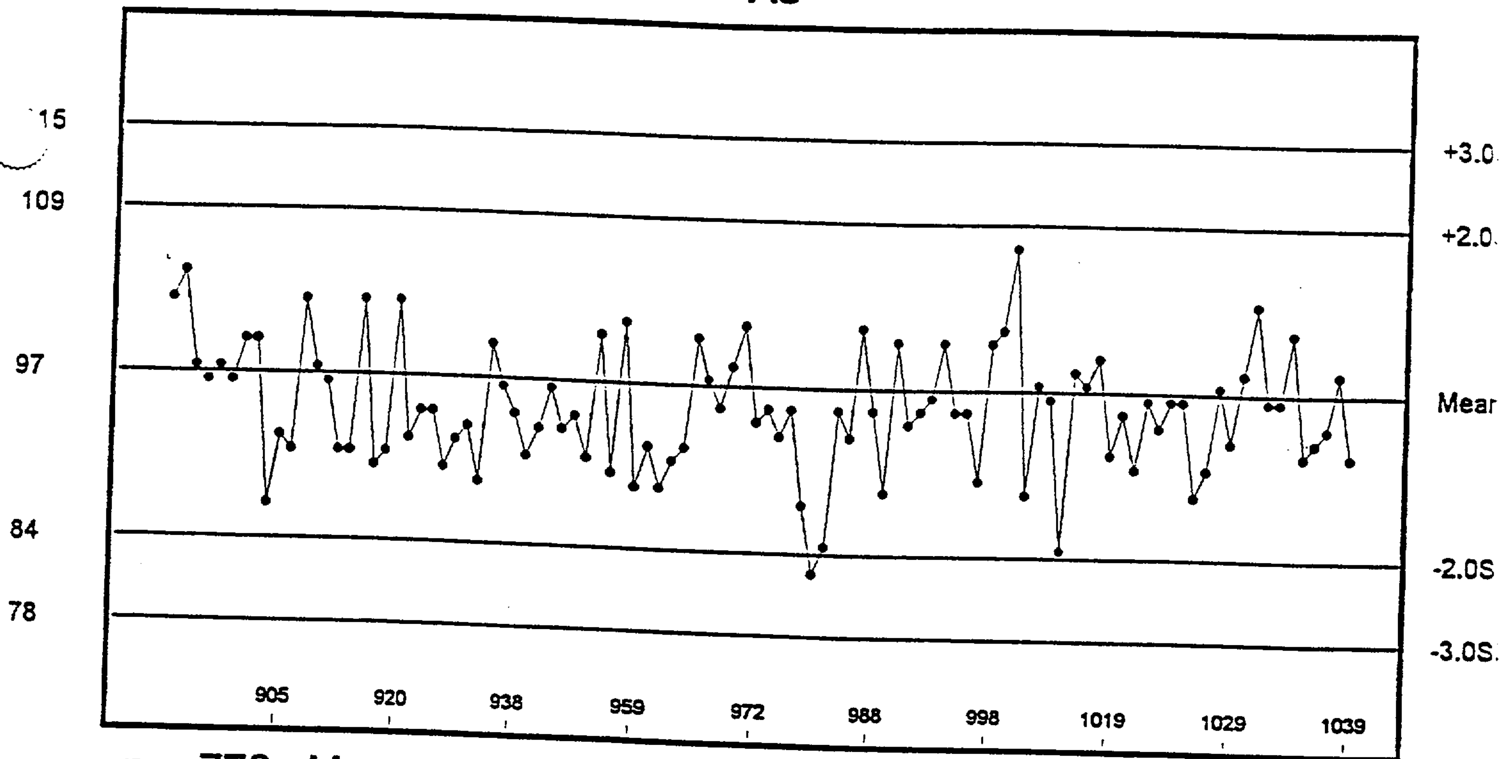
At any time without reason either Spectrace Instruments or the customer may cancel this Agreement. Written notification of cancellation is required. Spectrace Instruments will refund the unused prorated portion of the Agreement rounded to the end of the month cancellation takes place. This Agreement will be null and void at the end of the month cancellation takes place. Allow sixty (60) days for refund. Any refunded portion may be withheld to pay outstanding debt to Spectrace.

ATTACHMENT 9

QUALITY CONTROL CHARTS

IH SPC Chart

As

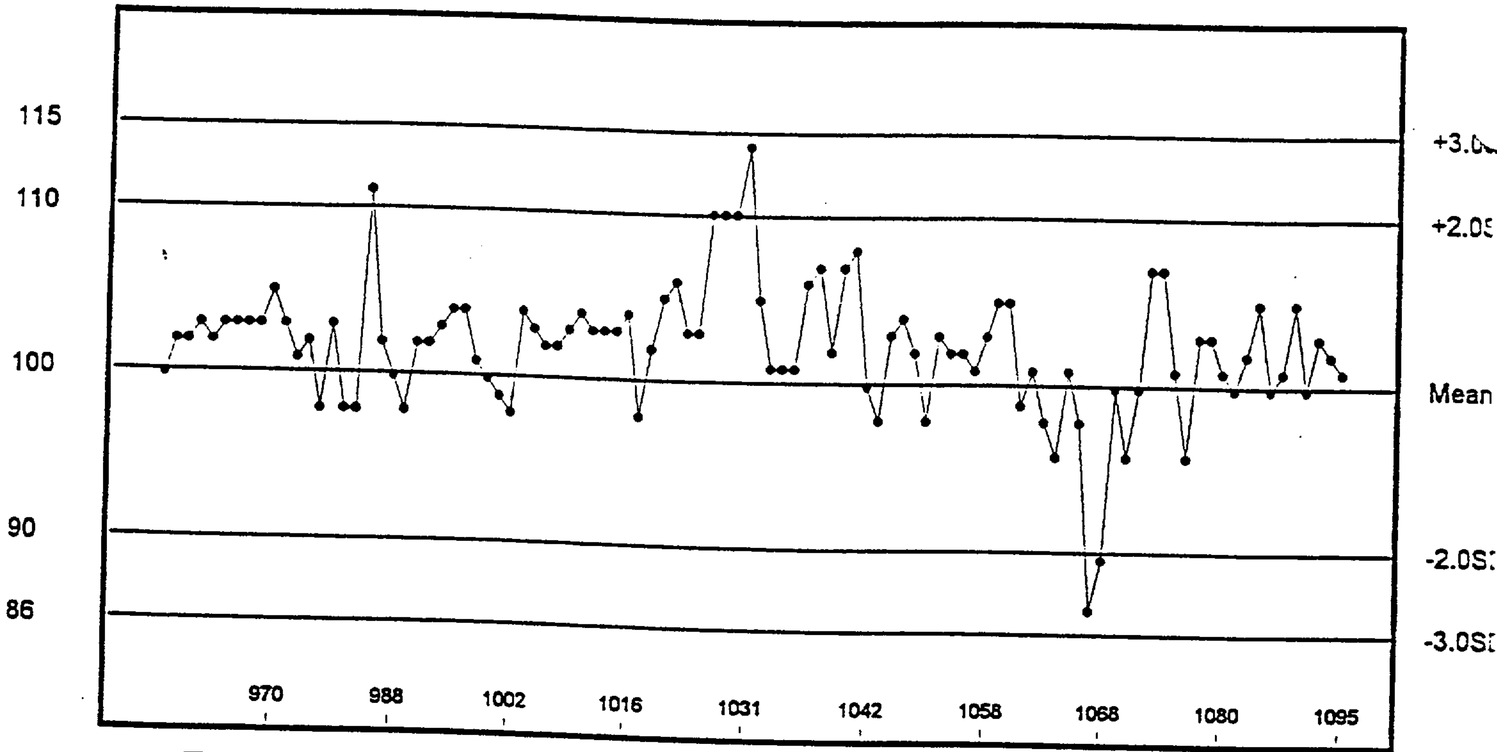


n= 776 Mean= 97 SD= 6 CV= 6.28% Min= 82 Max= 117

File: C:\CCPRO\IH.CCP

Column As

In SPC Chart
Cd



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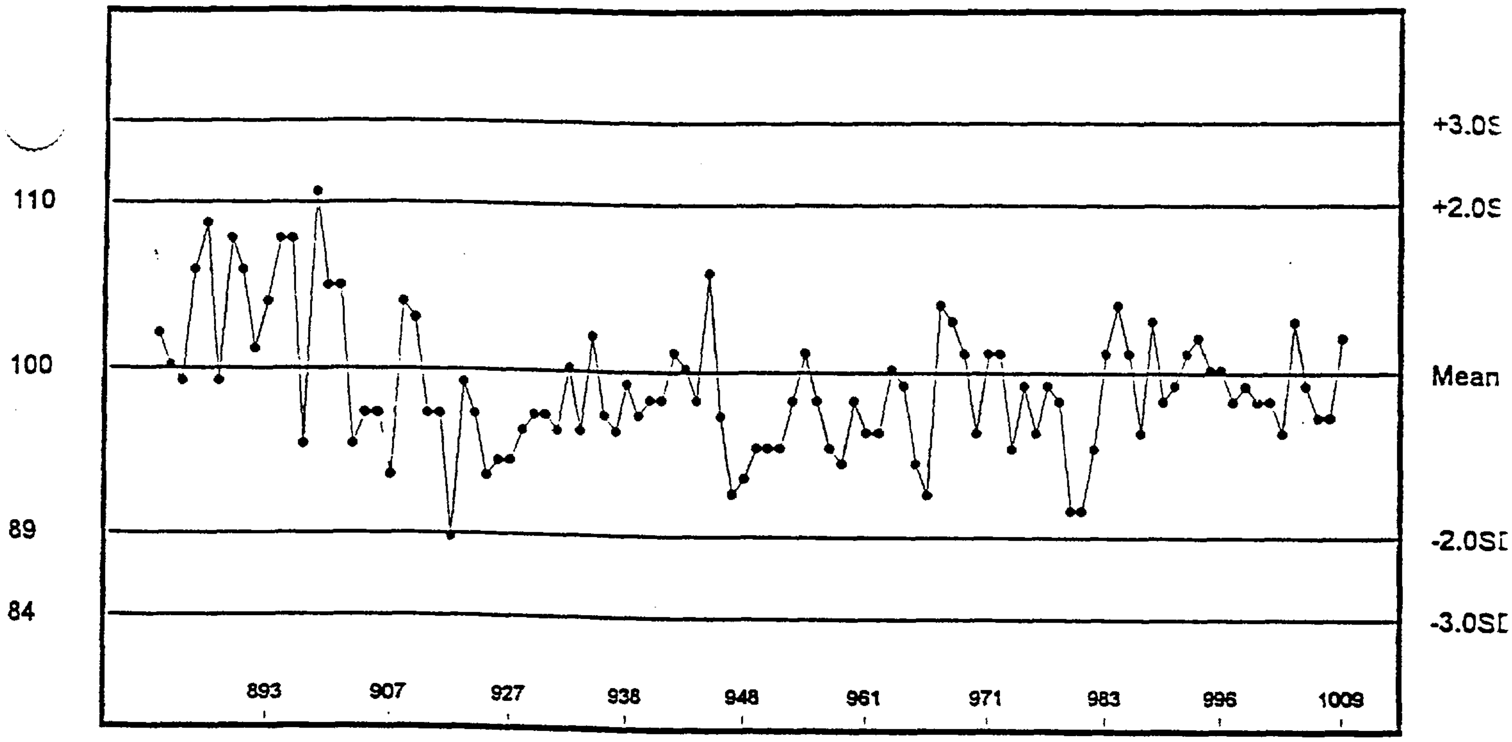
olumn Cd

IH SPC Chart

Pb



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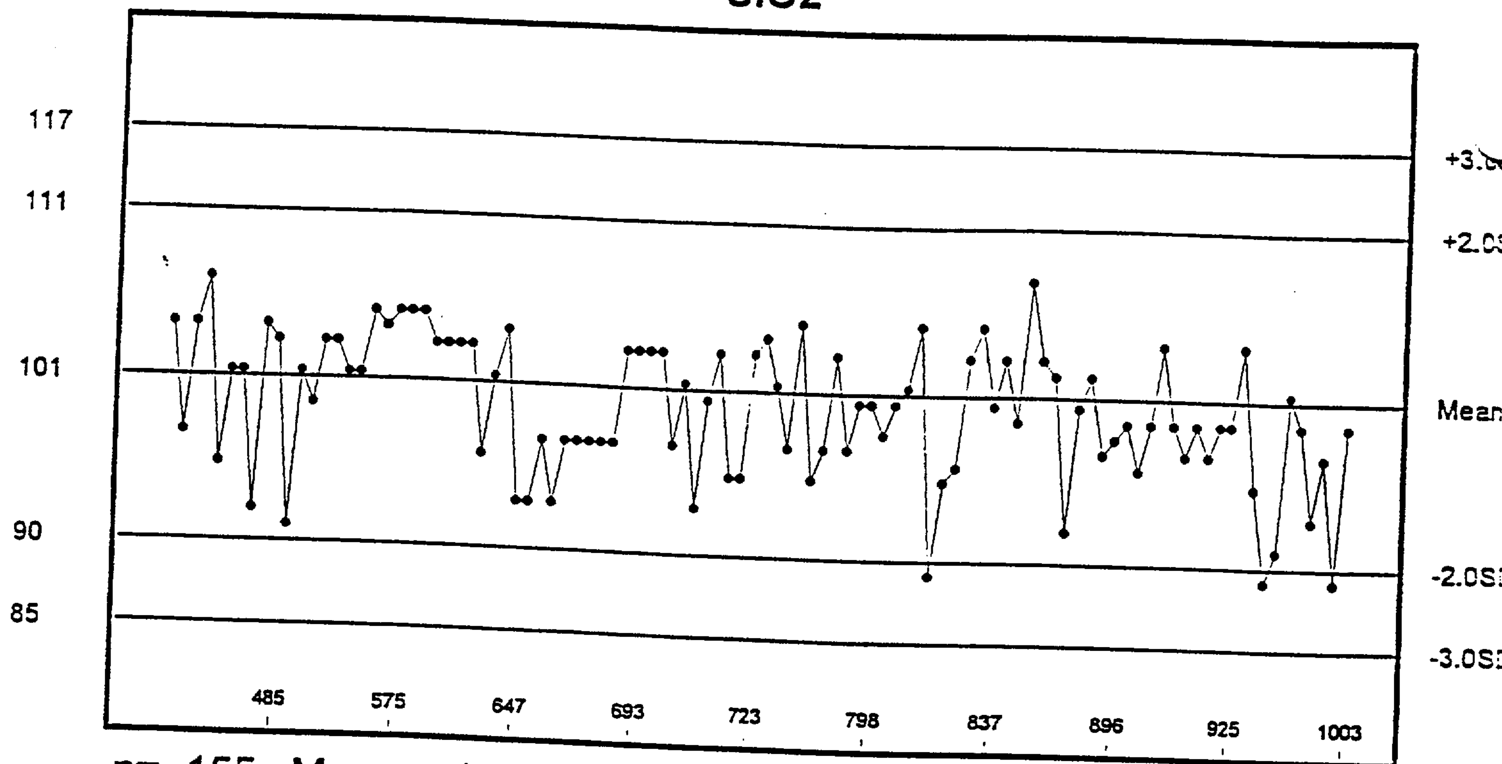
olumn Pb

IH SPC Chart
SiO2



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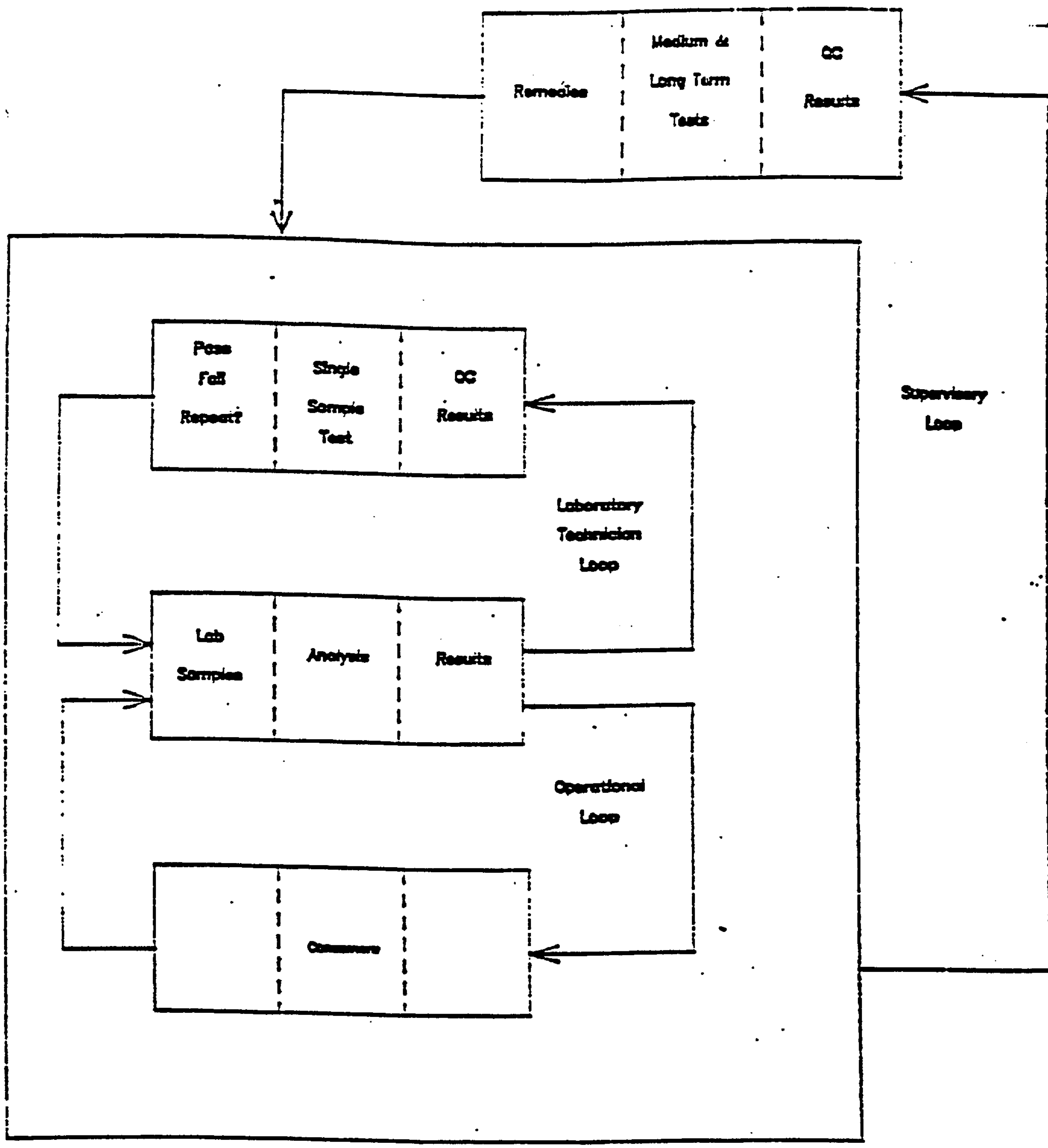
Column SiO2

ATTACHMENT 10

CONTROL LOOP

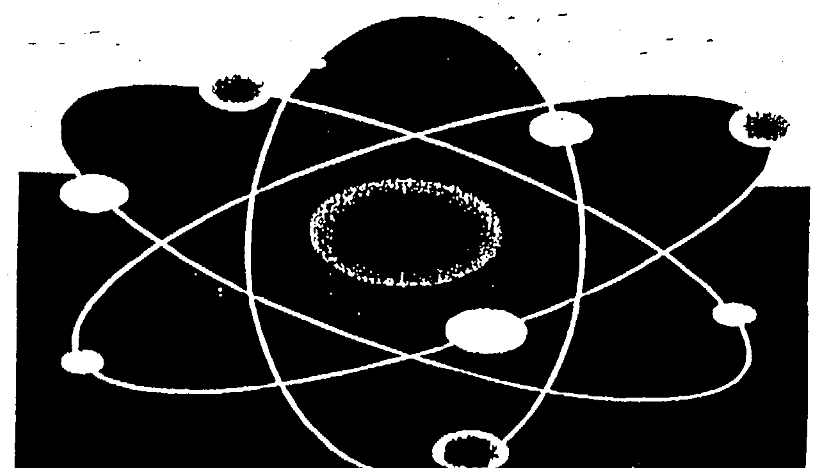

Remedies
Medium &
Long Term
Tests
QC
Results
Supervisory
Loop
Pass
Fail
Repeat?
Single
Sample
Test
QC
Results
Laboratory
Technician
Loop
Lab
Samples
Analysis
Results
Operational
Loop
Consumers

ATTACHMENT 11

STANDARDS LOG

PERKIN-ELMER OMTIMA 3000DV

ANALYSIS LOGBOOK 1



Optima 3000 DV Standards Log #26

Calibration Standard #1

Environmental Resource Associates ICP Calibration Standard #3
Lot #1097
1.0 ppm Ba, Be, Cd, Cr, Co, Cu, Mn, Mo, Ni, Pb, Sb, V and Zn
10 ppm Al, Fe, Mg and Se
In 0.5%, v/v, HCl and 0.5%, v/v, HNO_3

In use from December 3, 1997 to present.

Calibration Standard #2

50 ppm Ca
Mallinckrodt $CaCO_3$ (99.85%) lot #CXN. From 1000 ppm stock prepared April, 1995 by GJS.
In 10%, v/v, HCl

In use from January 16, 1998 to present

Calibration Standard #3

1 ppm As^{+5}
NBS 83c As_2O_3. From 1000 ppm stock prepared September, 1995 by GJS.
In 10%, v/v, HCl

In use from February 27, 1998 to present

Calibration Standard #4

5 ppm Ag
J.T. Baker $AgNO_3$, lot #45088. From 1000 ppm stock prepared December, 1996 by GJS.

5 ppm Tl
$TlNO_3$, lot #1-80. From 1000 ppm stock prepared April, 1995 by GJS.

In 10%, v/v, HCl

In use from October 16, 1997 to present

Calibration Standard #5

50 ppm K
J.T. Baker KCl, lot #58.0.0. From 1000 ppm stock prepared March, 1996 by GJS.

50 ppm Na
J.T. Baker NaCl, lot #57.0.0. From 1000 ppm stock prepared December, 1995 by GJS.

In 10%, v/v, HCl

In use from February 19, 1998 to present

Calibration Standard #6

5 ppm Au
ASARCO Central Research Au metal (99.99+%). From 1000 ppm stock prepared June, 1996 by GJS.
In 10%, v/v, HCl

In use from February 11, 1998 to present

ANALYST: JJT DATE: 4-27-98

SAMPLE SOURCE: Globe C980676-33 to 39. UPCM C980754-1; C980755-1 to 2. Leadville C980758-1. Tacoma C980786-1 to 3. BioTrace C980808-1 to 2. East Helena C980862-1 to 6. El Paso C980825-1 to 6. Envirocare C980823-1 to 2. El Paso C980778-1 to 4; C980792-1; C980799-1 to 4; C980793-1 to 4. Certified Castings C980846-1 to 3. East Helena C980712-1 to 90.

STANDARDS LOT #: Calibration standards #1, 2, 3, 4, 5, 6 & 7.

ANALYST: JJT DATE: 4-28-98

SAMPLE SOURCE: El Paso C980858-1 to 4. East Helena C980814-1; C980712-91 to 185.

STANDARDS LOT #: Calibration standards #1, 2, 3, 4, 5, 6 & 7.

ATTACHMENT 12

CERTIFICATIONS

Utah Department of Health

DIVISION OF EPIDEMIOLOGY AND LABORATORY SERVICES

State of Utah

Michael O. Leavitt
Governor

Rod L. Betit
Executive Director

Charles D. Brokopp, Dr. P.H.
Director

Bureau of Laboratory Improvement
46 North Medical Drive
Salt Lake City, Utah 84113-1105
Telephone: (801) 584-8469
Fax: (801) 584-8501
http://hlunix.hl.state.ut.us/els/labimp

January 4, 2001

ASARCO/AEC Laboratory
Gary Stanga Director
3422 South 700 West
Salt Lake City UT 84119

ID # ASAR
Account # 2622459

Director,

On the basis of your most recent audit results and compliance with the ELCP requirements, the laboratory listed is certified for environmental monitoring under the Clean Water Act and authorized to perform the following analytes, or groups of analytes by method:

Inorganics and Metals

5520 B
- Oil and Grease by Partition-Gravimetric Method

HACH Method
- COD

Method 120.1
- Conductance (Specific Conductance, umhos at 25-C)

Method 150.1
- pH (Electrometric)

Method 160.1
- Residue, Filterable (Gravimetric)

Method 160.2
- Residue, Non-Filterable (Gravimetric, TSS)

Method 180.1
- Turbidity (Nephelometric)

Method 200.7
- Antimony
- Arsenic
- Barium
- Beryllium
- Cadmium
- Calcium
- Chromium
- Cobalt
- Iron
- Lead
- Magnesium
- Manganese
- Molybdenum
- Nickel
- Potassium
- Selenium
- Silver
- Sodium
- Thallium
- Vanadium
- Zinc

Method 200.8
- Antimony
- Arsenic
- Barium
- Beryllium
- Cadmium
- Chromium
- Cobalt
- Lead
- Manganese
- Molybdenum
- Nickel
- Selenium
- Silver
- Thallium
- Vanadium
- Zinc

Method 204.2
- Antimony (Atomic Absorption, Furnace Technique)

Method 206.2
- Arsenic (Atomic Absorption, Furnace Technique)

Method 206.3
- Arsenic (Atomic Absorption, Gaseous-Hydride)

The expiration for the laboratory's certification is 03/31/2001. The Utah Environmental Laboratory Certification Program (ELCP) encourages clients and data user to verify the most current certification letter for the authorized method. Please call 801-584-8469.

Method 213.1
Cadmium (Atomic Absorption, Direct Aspiration)
Method 213.2
Cadmium (Atomic Absorption, Furnace Technique)
Method 2258.1
Potassium (Atomic Absorption, Direct Aspiration)
Method 2270.2
Selenium (Atomic Absorption, Furnace Technique)
Method 236.1
Iron (Atomic Absorption, Direct Aspiration)
Method 239.1
Lead (Atomic Absorption, Direct Aspiration)
Method 239.2
Lead (Atomic Absorption, Furnace Technique)
Method 245.1
Mercury (Manual Cold Vapor Technique)
Method 272.1
Silver (Atomic Absorption, Direct Aspiration)
Method 272.2
Silver (Atomic Absorption, Furnace Technique)
Method 273.1
Sodium (Atomic Absorption, Direct Aspiration)
Method 289.1
Zinc (Atomic Absorption, Direct Aspiration)
Method 310.1
Alkalinity (Titrimetric, pH 4.5)
Method 325.1
Chloride (Colorimetric, Automated Ferricyanide AAI)
Method 335.2
Cyanide, Total (Titrimetric; Spectrophotometric)
Method 340.2
Fluoride (Potentiometric, Ion Selective Electrode)
Method 350.1
Nitrogen, Ammonia (Colorimetric, Automated Phenate)
Method 351.1
Nitrogen, Kjeldahl, Total (Colorimetric, Automated Phenate)
Method 353.1
Nitrogen, Nitrate-Nitrite (Colorimetric, Automated, Hydrazine Reduction)
Method 365.1
Phosphorous, All Forms (Colorimetric, Automated, Ascorbic Acid)
Method 365.4
Phosphorous, Total (Colorimetric, Automated, Block Digester AA II)
Method 415.1
Organic Carbon, Total (Combustion Or Oxidation)
Method 420.1
Phenolics (Spectrophotometric, Manual 4-AAP With Distillation)

This laboratory's certification date is effective: 10/01/2000.

The analytes or groups of analytes by method which a laboratory is authorized to perform at any given time will be those indicated in the most recent certificate letter. The most recent certification letter supersedes all previous certification or authorization letters. Any discrepancies must be documented and notice received by this Bureau within 15 days of receipt. The certification will be recalled in the event your laboratory's certification is revoked.

Respectfully,

Charles Brokopp, Dr. P.H.

The expiration for the laboratory's certification is 03/31/2001. The Utah Environmental Laboratory Certification Program (ELCP) encourages clients and data user to verify the most current certification letter for the authorized method. Please call 801-584-8469.

Utah Department of Health

DIVISION OF EPIDEMIOLOGY AND LABORATORY SERVICES

State of Utah

Michael O. Leavitt
Governor
Rod L. Betit
Executive Director
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Director

Bureau of Laboratory Improvement
46 North Medical Drive
Salt Lake City, Utah 84113-1105
Telephone: (801) 581-8469
Fax: (801) 584-8501
http://hlunix.hl.state.ut.us/els/labimp

January 4, 2001

ASARCO/AEC Laboratory
Gary Stanga Director
3422 South 700 West
Salt Lake City UT 84119

ID # ASAR
Account # 2622459

Director,

On the basis of your most recent audit results and compliance with the ELCP requirements, the laboratory listed is certified for environmental monitoring under the Resource Conservation and Recovery Act and authorized to perform the following analytes, or groups of analytes by method:

Characteristics
- *1311*
  - Toxicity Characteristic Leaching Procedure Metals

Inorganic
- *9036*
  - Sulfides (Colorimetric, Automated, Methylthymol Blue, AA II)

Metal Digestion
- *3005*
  - Acid Digestion Total Recoverable or Dissolved Metals
- *3010*
  - Acid Digestion for Total Metals
- *3020*
  - Acid Digestion for Total Metals
- *3050*
  - Acid Digestion of Sediments, Sludges and Soils

Metals
- *6010*
  - Aluminum
  - Antimony
  - Arsenic
  - Barium
  - Beryllium
  - Cadmium
  - Calcium
  - Chromium
  - Cobalt
  - Lead
  - Magnesium
  - Manganese
  - Molybdenum
  - Nickel
  - Potassium
  - Selenium
  - Silver
  - Sodium
  - Thallium
  - Vanadium
  - Zinc
- *6020*
  - Antimony
  - Arsenic
  - Beryllium
  - Cadmium
  - Chromium
  - Cobalt
  - Lead
  - Manganese
  - Nickel
  - Silver
  - Thallium
  - Zinc
- *7470*
  - Mercury

The expiration for the laboratory's certification is 03/31/2001. The Utah Environmental Laboratory Certification Program (ELCP) encourages clients and data user to verify the most current certification letter for the authorized method. Please call 801-584-8469.

This laboratory's certification date is effective: 10/01/2000.

The analytes or groups of analytes by method which a laboratory is authorized to perform at any given time will be those indicated in the most recent certificate letter. The most recent certification letter supersedes all previous certification or authorization letters. Any discrepancies must be documented and notice received by this Bureau within 15 days of receipt. The certification will be recalled in the event your laboratory's certification is revoked.

Respectfully,

Charles Brokopp, Dr. P.H.

The expiration for the laboratory's certification is 03/31/2001. The Utah Environmental Laboratory Certification Program (ELCP) encourages clients and data user to verify the most current certification letter for the authorized method. Please call 801-584-8469.

Arizona
Department of
Health Services

ENVIRONMENTAL LABORATORY LICENSE

Issued to:

Laboratory Director: GARY STANGA
Owner/Representative: GARY STANGA, REPRESENTATIVE

ASARCO/AEC LABORATORY
AZ0599

is in compliance with Environmental Laboratory's applicable standards for the State of Arizona and maintains on file a List of Parameters for which the laboratory is certified to perform analysis.

PERIOD OF LICENSURE FROM: 01/20/2000 TO 01/20/2001

Wynand H. Nimmo, M.T., Chief
Office of Laboratory Licensure,
Certification & Training

Arizona Department of Health Services

Office of Laboratory Licensure, Certification & Training

3443 N. Central Avenue, Suite 810
Phoenix, Arizona 85012-2208
(602) 255-3454
(602) 255-3462 FAX
WATTS 1-800-952-0374

JANE DEE HULL, GOVERNOR
JAMES L. SCHAMADAN, M.D, ACTING DIRECTOR

April 7, 2000

Gary Stanga
ASARCO/AEC Laboratory
3422 South 700 West
Salt Lake City, ut 84119

Dear Mr. Stanga:

This is to confirm that **ASARCO/AEC LABORATORY** has fulfilled all requirements for Arizona Environmental Laboratory Licensure under the Arizona Revised Statute §§ 36.495 et.sec. and rules.

Your Arizona Environmental Laboratory License number is **AZ0599**, which is the number you will need to use when reporting compliance results to ADEQ or the USEPA.

If there are any questions, please do not hesitate to call me at the letterhead telephone number.

Sincerely,

Steven D. Baker, Manager
Environmental Laboratory Licensure
SDB:rm

State Laboratory
Environmental Laboratory Licensure Fees as of

Tuesday, December 28, 1999

AZLicense: AZ0599 | LabName: ASARCO/AEC LABORATORY

EntryDate: 11/6/1998 | CertDate:

Division:
MailStreet: 3422 SOUTH 700 WEST
MailCity: SALT LAKE CITY   MainPhone: (801) 263-5251   EXT.:
MailST: UT   MailZip: 84119   FAX: (801) 264-9838

Owner/Rep.: GARY STANGA, REPRESENTATIVE
LabDirector: GARY STANGA   Title: LABORATORY DIRECTOR

LICENSURE CATEGORIES	TOTAL LICENSED METHODS	FEE
HAZARDOUS CHARACTERISTIC TESTING	2	$362.00
INORGANIC CHEMISTRY - METALS	40	$369.00
INORGANIC CHEMISTRY - NONMETALS	14	$464.00
INSTRUMENTS	3	$181.00
MISCELLANEOUS COMPLIANCE TESTING	11	$316.00
Non Billables	3	$0.00

Total Licensed Methods and Instruments:	73
Fee for approved Methods and Instrumentation:	$1,692.00
Proficiency evaluation audit fee:	$78.00
Techinical Updates Fees:	$75.00
0 Billable deletions in accordance with R9-14-606.E.:	$0.00
Amount DUE in accordance with R9-14-603:	**$1,845.00**
Payment received	-1,799.00
Balance due	$ 46.00

*If no figures present, you are NOT billed for deletions

Programs: AIR = Air   HW = Hazardous Waste   SDW = Safe Drinking Water   WW = Wastewater

Arizona Department of Health Services
State Laboratory
Environmental Laboratory Licensure Invoice Detail

AZLicense	AZ0599	LabName	ASARCO/AEC LABORATORY

Division:
MailStreet: 3422 SOUTH 700 WEST
MailCity: SALT LAKE CITY
MailST: UT MailZip: 84119
MainPhone: (801) 263-5251 EXT:
FAX: (801) 264-9838

EntryDate: 11/6/1998
CertDate:

Owner/Rep: GARY STANGA, REPRESENTATIVE
LabDirector: GARY STANGA
Title: LABORATORY DIRECTOR

PROGRAM: HW

PARAMETER	METHOD	DATE
ARSENIC	EPA 6010B	11/6/1998
BARIUM	EPA 6010B	11/6/1998
CADMIUM	EPA 6010B	11/6/1998
CHROMIUM, TOTAL	EPA 6010B	11/6/1998
COPPER	EPA 6010B	11/6/1998
CORROSIVITY PH DETERMINATION	EPA 9040A	11/6/1998
LEAD	EPA 6010B	11/6/1998
MERCURY	EPA 7470A	11/6/1998
SEDIMENTS, SLUDGES AND SOILS	EPA 3050B	11/6/1998
SELENIUM	EPA 6010B	11/6/1998
SILVER	EPA 6010B	11/6/1998
SULFATE	EPA 9036	11/6/1998
SYNTHETIC PRECIPITATION LEACHING PROCEDURE (SPLP)	EPA 1312	11/22/1999
TOTAL METALS	EPA 3010A	11/6/1998
TOTAL RECOVERABLE IN WATER	EPA 3005A	11/6/1998
TOXICITY CHARACTERISTICS LEACHING PROCEDURE	EPA 1311	11/6/1998
ZINC	EPA 6010B	11/6/1998

Total Licensed Parameters in this Program: 17

PROGRAM: WW

PARAMETER	METHOD	DATE
ALKALINITY, TOTAL	EPA 310.1	11/6/1998
AMMONIA	EPA 350.1	11/6/1998
ANTIMONY	EPA 200.7	11/6/1998
ANTIMONY	EPA 200.8	11/6/1998
ARSENIC	EPA 200.7	11/6/1998

ograms:

Arizona Department of Health Services
State Laboratory
Environmental Laboratory Licensure Invoice Detail

Tuesday, December 28, 1999

AZLicense: AZ0599 LabName: ASARCO/AEC LABORATORY

PROGRAM: WW

PARAMETER	METHOD	DATE
ARSENIC	EPA 200.8	11/6/1998
BARIUM	EPA 200.7	11/6/1998
BERYLLIUM	EPA 200.7	11/6/1998
BERYLLIUM	EPA 200.8	11/6/1998
CADMIUM	EPA 200.7	11/6/1998
CADMIUM	EPA 200.8	11/6/1998
CALCIUM	EPA 200.7	11/6/1998
CHLORIDE	EPA 325.1	11/6/1998
CHROMIUM TOTAL	EPA 200.7	11/6/1998
CHROMIUM TOTAL	EPA 200.8	11/6/1998
COBALT	EPA 200.7	11/6/1998
COBALT	EPA 200.8	11/6/1998
COPPER	EPA 200.7	11/6/1998
COPPER	EPA 200.8	11/6/1998
CYANIDE, TOTAL	EPA 335.2	11/6/1998
FLUORIDE	EPA 340.2	11/6/1998
HARDNESS	EPA 200.7,CA&M	11/6/1998
HYDROGEN ION (pH)	EPA 150.1	11/6/1998
IRON	EPA 200.7	11/6/1998
KJELDAHL NITROGEN	EPA 351.1	11/6/1998
LEAD	EPA 200.7	11/6/1998
LEAD	EPA 200.8	11/6/1998
MAGNESIUM	EPA 200.7	11/6/1998
MANGANESE	EPA 200.7	11/6/1998
MANGANESE	EPA 200.8	11/6/1998
MERCURY	EPA 245.1	11/6/1998
MOLYBDENUM	EPA 200.7	11/6/1998
MOLYBDENUM	EPA 200.8	11/6/1998
NICKEL	EPA 200.7	11/6/1998
NICKEL	EPA 200.8	11/6/1998
NITRATE	EPA 353.1	11/6/1998
OIL AND GREASE	SM 5520B	11/6/1998
ORTHOPHOSPHATE	EPA 365.1	11/6/1998
PHOSPHORUS TOTAL	EPA 365.4	11/6/1998
POTASSIUM	EPA 200.7	11/6/1998
RESIDUE FILTERABLE (TDS)	EPA 160.1	11/6/1998

Programs

Arizona Department of Health Services
State Laboratory
Environmental Laboratory Licensure Invoice Detail

Tuesday, December 28, 1999

AZLicense: AZ0599 LabName: ASARCO/AEC LABORATORY

PROGRAM: WW

PARAMETER	METHOD	DATE
RESIDUE NONFILTERABLE (TSS)	EPA 160.2	11/6/1998
SELENIUM	EPA 200.7	11/6/1998
SELENIUM	EPA 200.8	11/6/1998
SILVER	EPA 200.7	11/6/1998
SILVER	EPA 200.8	11/6/1998
SPECIFIC CONDUCTANCE	EPA 120.1	11/6/1998
THALLIUM	EPA 200.7	11/6/1998
THALLIUM	EPA 200.8	11/6/1998
VANADIUM	EPA 200.7	11/6/1998
VANADIUM	EPA 200.8	11/6/1998
ZINC	EPA 200.7	11/6/1998
ZINC	EPA 200.8	11/6/1998

Total Licensed Parameters in this Program: 53

Total Licensed Parameters for this Lab: 70

INSTRUMENTS	QUANTITY	DATE
MERCURY ANALYZER	1	11/6/1998
INDUCTIVELY COUPLED PLASMA SPECTROMETER	1	11/6/1998
INDUCTIVELY COUPLED PLASMA/MASS SPECTROMETER	1	11/6/1998

ATTACHMENT 13

ANALYTICAL REPORTS

ASARCO

December 22, 1998

Mr. [redacted]

Please find attached the analytical results for the HDS water sample collected December 14, 1998.

The sample was received by the laboratory on December 18, 1998.

Results were faxed to you on December 22, 1998.

Sincerely,

John H. Nokes
Laboratory/Environmental
Technician

cc: GRStanga (w/attach.)
JLloyd "
Ramachandran "

ASARCO Incorporated 3422 South 700 West, Salt Lake City, Utah 84119-4191 (801) 252-2459 FAX (801) 261-2194

ASARCO TECHNICAL SERVICES CENTER

ANALYTICAL DATA REPORT

[redacted]

Water and Solid Waste (Project 3119)

Batch No: L982521

LAB NO	DATE COLLECTED	DESCRIPTION	PARAMETER	VALUE	UNITS	ANALYST	DATE ANALYZED	HOLD DAYS	METHOD
L982521-1	14-DEC-98	HDS-E001 HDS Effluent	AS(TR)	.11	ppm	BD	21-DEC-98	180	6020
			CD(TR)	.001	ppm	BD	21-DEC-98	180	6020
			CU(TR)	<.010	ppm	BD	21-DEC-98	180	6020
			FE(TR)	.61	ppm	JJT	18-DEC-98	180	6010
			HG	<.60	ppb	VPK	22-DEC-98	28	245.1
			PB(TR)	.005	ppm	BD	21-DEC-98	180	6020
			SE(TR)	.95	ppm	BD	21-DEC-98		6020
			TL(TR)	2.2	ppm	JJT	18-DEC-98	180	6010
			ZN(TR)	.61	ppm	JHN	18-DEC-98	180	289.1

*SW846-3005 method of preparation for (TR) metals.

Vince [illegible]

Approved

[illegible]

Reviewer

ASARCO TECHNIC[illegible]RVICES CENTER

ANALYTICAL DATA REPORT

[redacted]

Water and Solid Waste (Project 3119)

Batch No: WG981540

LAB NO	DATE COLLECTED	DESCRIPTION		PARAMETER	VALUE	UNITS	ANALYST	DATE ANALYZED	HOLD DAYS	METHOD
WG981540-1		Matrix Spike	L982521-1	AS(TR)	103.	% RECOVERY	BD	21-DEC-98		6020
				CD(TR)	97.	% RECOVERY	BD	21-DEC-98		6020
				CU(TR)	91.	% RECOVERY	BD	21-DEC-98		6020
				FE(TR)	104.	% RECOVERY	JJT	18-DEC-98		6010
				HG	82.	% RECOVERY	VPK	22-DEC-98		245.1
				PB(TR)	103.	% RECOVERY	BD	21-DEC-98		6020
				SE(TR)	110.	% RECOVERY	BD	21-DEC-98		6020
				TL(TR)	97.	% RECOVERY	JJT	18-DEC-98		6010
				ZN(TR)	106.	% RECOVERY	JHN	18-DEC-98		289.1
WG981540-2		Duplicate	L982521-1	AS(TR)	<1.0	% RPD	BD	21-DEC-98		6020
				CD(TR)	9.5	% RPD	BD	21-DEC-98		6020
				CU(TR)	13.6	% RPD	BD	21-DEC-98		6020
				FE(TR)	<1.0	% RPD	JJT	18-DEC-98		6010
				HG	<1.0	% RPD	VPK	22-DEC-98		245.1
				PB(TR)	<1.0	% RPD	BD	21-DEC-98		6020
				SE(TR)	2.1	% RPD	BD	21-DEC-98		6020
				TL(TR)	3.3	% RPD	JJT	18-DEC-98		6010
				ZN(TR)	1.6	% RPD	JHN	18-DEC-98		289.1
WG981540-3		Laboratory Control	EEICQ-50/FSHR	AS(TR)	107.	% RECOVERY	BD	21-DEC-98		6020
				CD(TR)	101.	% RECOVERY	BD	21-DEC-98		6020
				CU(TR)	95.	% RECOVERY	BD	21-DEC-98		6020
				FE(TR)	98.	% RECOVERY	JJT	18-DEC-98		6010
				HG	91.	% RECOVERY	VPK	22-DEC-98		245.1
				PB(TR)	105.	% RECOVERY	BD	21-DEC-98		6020
				SE(TR)	112.	% RECOVERY	BD	21-DEC-98		6020
				TL(TR)	97.	% RECOVERY	JJT	18-DEC-98		6010
				ZN(TR)	98.	% RECOVERY	JHN	18-DEC-98		289.1
WG981540-4		Prep Blank	12/18/98	AS(TR)	<.005	ppm	BD	21-DEC-98		6020
				CD(TR)	<.001	ppm	BD	21-DEC-98		6020
				CU(TR)	<.010	ppm	BD	21-DEC-98		6020
				FE(TR)	<.020	ppm	JJT	18-DEC-98		6010
				HG	<.60	ppb	VPK	22-DEC-98		245.1
				PB(TR)	<.003	ppm	BD	21-DEC-98		6020
				SE(TR)	<.005	ppm	BD	21-DEC-98		6020
				TL(TR)	<.020	ppm	JJT	18-DEC-98		6010
				ZN(TR)	<.020	ppm	JHN	18-DEC-98		289.1

ASARCO TECHNICAL SERVICES CENTER

ANALYTICAL DATA REPORT

[redacted]

Water and Solid Waste (Project 3119)

Batch No: WG981540

LAB NO	DATE COLLECTED	DESCRIPTION	PARAMETER	VALUE	UNITS	ANALYST	DATE ANALYZED	HOLD DAYS	METHOD
WG981540-5		Practical Quantitation Limit	AS(TR)	.005	ppm				6020
			CD(TR)	.001	ppm				6020
			CU(TR)	.010	ppm				6020
			FE(TR)	.030	ppm				6010
			HG	.60	ppb				245.1
			PB(TR)	.003	ppm				6020
			SE(TR)	.005	ppm				6020
			TL(TR)	.020/.003	ppm				6010/6020
			ZN(TR)	.020	ppm				289.1

Vince Kelly
Approved

Bilqis Dhelly
Reviewer

Standard Operating Procedure

Alkalinity - EPA Method 310.1

Parameter - Alkalinity

Range of Measurement - 1.0 mg/liter to 10,000 mg/liter

Method Detection Limit - 0.8 mg/liter. Calculated in accordance with 40 CFR part 136, Appendix B.

Sample Matrix - Water

Principle, Scope & Application - A sample is titrated to an end point of pH 4.5 with .02 N sulfuric acid. Do not filter, dilute, concentrate or alter sample. This method applies to drinking, surface and saline waters, domestic and industrial wastes.

Interferences & Corrective Actions - Soaps, oily matter and precipitates may cause sluggish electrode response. Allow additional time between titrant additions to let the electrode equilibrate.

Safety Precautions - Refer to the MSDS for sulfuric acid.
Standard laboratory protective devices are to be utilized (safety glasses, lab coats and gloves).

Sample Size, Collection, Preservation and Handling - The sample is unpreserved and refrigerated at 4° C. The sample is allowed to equilibrate to room temperature prior to analysis.

Apparatus - pH meter with glass electrode
Magnetic stirrer, pipets, flasks and other standard laboratory equipment.
Buretts, Pyrex 50, 25 and 10 ml.

Routine Preventative Maintenance - Store electrode as per manufacturers instructions.

Reagent & Calibration Standards - .02 N sulfuric acid made from Dilut-It brand primary standard ampule.
pH 4, 7, and 10 buffer solutions

Calibration Procedures - Calibrate pH meter as per manufacturers instructions.

Sample Preparation - Allow sample to equilibrate to room temperature prior to analysis.

Analytical Measurement / Procedure - Sample size:
Use a sufficiently large volume of titrant (>20 ml in a 50 ml buret) to obtain a good precision while keeping volume low enough to permit sharp end point.
For <1000 mg $CaCO_3$/1 use 0.02 N titrant
For <1000 mg $CaCO_3$/1 use 0.1 N titrant
A preliminary titration is helpful.
Potentiometric titration:
Place sample in flask by pipetting with pipet tip near bottom of flask
Measure pH of sample
Add standard acid, being careful to stir thoroughly but gently to allow needle to obtain equilibrium.
Titrate to pH 4.5. Record volume of titrant.
Potentiometric titration of low alkalinity:
For alkalinity of <20 mg/1 titrate 100-200 ml as above using a 10 ml microburette and 0.02 N acid solution.
Stop titration at pH in range of 4.3-4.7, record volume and exact pH. Very carefully add titrant to lower pH exactly 0.3 pH units and record volume.

Data Treatment - Calculations:

Potentiometric titration to pH 4.5

$$\text{Alkalinity, mg/1 } CaCO_3 = \frac{A \times N \times 50{,}000}{\text{ml of sample}}$$

where:
A = ml standard acid

N = normality standard acid
Potentiometric titration of low alkalinity:

$$\text{Total alkalinity, mg/1}CaCO_3 = \frac{(2B - C) \times N \text{ X } 50{,}000}{\text{ml of sample}}$$

where:
B = ml titrant to first recorded pH
C = total ml titrant to reach pH 0.3 units lower
N = normality of acid
Data is recorded in the laboratory notebooks, utilizing standard practices, (i.e. Each page is dated and initialed). Data is logged out on the LIMS system. A hard copy of the data is kept on the file with the analysts copy of the report.

Data Deliverables -Data deliverables for this project include all raw data including laboratory notebooks.

Quality Control Requirements -Quality control includes blanks, duplicates, standard reference materials. Frequency is 1 per 20 samples.

References - Methods for Chemical Analysis of Water and Wastes.

Method Validation Data -Refer to Methods for Chemical Analysis of Water and Wastes.

Standard Operating Procedure

Chloride in Water - EPA 325.2

Parameter - Chloride

Range of Measurement - 1 to 100 ppm Chloride

Method Detection Limit - .77 ppm calculated in accordance with 40 CFR part 136, Appendix D.

Sample Matrix - Water

Principle, Scope & Application - Thiocyanate ion (SCN) is liberated from mercuric thiocyanate through sequestration of mercury by chloride ion to form un-ionized mercuric chloride. In the presence of ferric ion, the liberated SCN forms highly colored ferric thiocyanate in concentration proportional to the original chloride concentration. This method applies to drinking, surface, and saline waters, domestic and industrial wastes.

Interferences & Corrective Actions - No significant interferences.

Safety Precautions -Refer to MSDS's for mercuric thiocyanate solutions. Standard laboratory protective devices are to be utilized (safety glasses, lab coats and gloves).

Sample Size, Collection, Preservation and Handling - Samples are unpreserved and refrigerated at 4° C. The holding time for chloride is 28 days.

Apparatus - Alpkem model 3590 automated colorimetric segmented flow analyzer.

Routine Preventative Maintenance - Chloride is the simplest and most trouble free run on the instrument.
Replace pump tubes and ferrules as wear and tear requires.
The reagent must be filtered through .45 micrometer filter.
The reagent must be capped at all times.

Note: Collect and dispose of the waste as indicated in page 7 of the manual.

Reagent & Calibration Standards

a. Stock Mercuric Thiocyanate: Dissolve 4.17g of mercuric thiocyanate (FW 316.75) in 500ml methanol (FW 32.04), mix and dilute solution to 1000ml with methanol. Filter.

b. Stock Ferric Nitrate: Dissolve 202g of ferric nitrate (FW 404.0) in 500ml of deionized water, add 31.5ml nitric acid (FW 63.02) , mix and dilute the solution to 1000ml with deionized water. Filter.

c. Working Chloride Color Reagent: Add 30ml of Stock Mercuric Thiocyanite and 30ml of Stock Ferric Nitrate solution to 100 ml deionized water. Dilute the solution to 200ml with deionized water.

d. Carrier: Add 2ml of Brij-35, 30% w/v to 1000ml of deionized water.

-The stock calibrant is a 1000 ppm solution utilizing 1.64838 g of sodium chloride diluted to one liter with deionized water. Serial dilutions are made for standards at 2, 5, 10, 25, 50, 75 and 100 ppm.

Calibration Procedures - A calibration curve must be prepared each day for each sample run with a calibration blank and 2, 5, 10, 25, 50, 75 and 100 ppm standards. After calibration, the calibration curve must be verified by use of at least a calibration blank and a calibration check standard (made from a reference material or other independent standard material) at or near the mid-range. The calibration reference must be measured within 10% of it's true value for the curve to be considered valid.

Sample Preparation - Samples are allowed to equilibrate to room temperature prior to analysis. Turbid samples are filtered prior to analysis.

Analytical Measurement - SETTING UP THE RUN ON THE SAMPLER:
The Detector 510 and Sampler 501 should be adjusted according to the instructions on page 15 of the chloride section in the manual.
To set up the 502b pump turn to page 14.
Turn to page 7 for Operation Procedure.
BEGIN ANALYSIS.
Settings on the 510 detector should be the following: page 15

-wavelength	480
-range	0.2 AUFS
-rise time	10 sec.

The settings on the 501 sampler should be the following: page 15

-sample time	20 sec.
-wash time	60 sec.
-pecking	on

Procedure

- Set up manifold and reagents.
- Allow 30 minute warm up and pump reagents until a stable baseline is achieved.

-Construct calibration curve

-Analyze samples.

Data Treatment -A computer data printout is obtained from the Alpkem 3590 system. This includes calibration curves, correlation coefficients, concentrations and associated intensities. Data is logged out on the LIMS system. A hard copy of the data is kept on file with the analysts copy of the report.

Data Deliverables -Standard data deliverables include sample date, date of analysis, method of analysis and the analysts initials. Date of sample receipt is noted in the reporting cover letter. Data deliverables may or may not include quality control summaries and/or raw data dependent upon the clients request.

Quality Control Requirements -In brief, the quality control includes; 1) the following four QC samples - Preparation Blank, Duplicate, Matrix Spike and Laboratory Control Sample and 2) the following run QC; initial and continuing calibration verifications, initial and continuing calibration blanks.

The following table summarizes quality control limits and frequency requirements.

QUALITY CONTROL SAMPLES	FREQUENCY	LIMITS
Prep Blanks	1 per batch of 20 or less	< PQL (Practical Quantitation Limit)
Laboratory Control Sample	1 per batch of 20 or less	80-120%
Duplicate	1 per batch of 20 or less	20% RPD, if <5 X PQL

Spike	1 per batch of 20 or less	75-125%
Initial Calibration Verification	after every calibration	90-110%
Initial Calibration Blank	after every calibration	< PQL
Continuing Calibration Verification	10%	90-110%
Continuing Calibration Blanks	10%	< PQL

References -Enviroflow 3500 Technical Information Perstorp Operators Manual.
The Flow Solution Operation Manual - Alpkem/Perstorp Analytical SoftPac (tm) Plus Manual- Perstorp Analytical
EPA Methods for Analysis of Water and Wastes

Method Validation Data -Refer to EPA Methods for Chemical Analysis of Water and Wastes - Method 325.2.

STANDARD OPERATION PROCEDURE
FOR
ENVIRONMENTAL DIGESTIONS
(UPDATED 4/23/97)

Please review the following guidelines in order to insure a consistent and appropriate approach to sample digestion and reporting. Digestions will be conducted in laboratory clean glassware and **covered** throughout the course of the digestion.

1. **WATER SAMPLES**

For analysis of water samples, we reference "EPA Methods for Chemical Analysis of Water and Wastes (200 series numbers (ie: 239.1 for flame AA analysis of Pb). We also reference EPA SW 846, (ie: 6010 for ICP). The sample digestion for water samples should be consistent with these documents. The documents should be reviewed for details.

A. **Total Metals**

Measure an appropriate aliquot of sample (usually 50 mls), add 3 mls concentrated HNO_3 and evaporate to near dryness (no area of the beaker is to go dry). Add 5 mls of concentrated HNO_3 and reflux to near dryness. Add 10 mls of 1:1 HCL and 15 mls DI H_2O per 100 mls of final solution and warm for 15 minutes to dissolve any precipitate. Build to an appropriate final volume (usually 50 mls).

B. **Total Recoverable Metals**

To an appropriate volume of sample add 2 mls 1:1 HNO_3 and 10 mls 1:1 HCL and reduce volume on hot plate to approximately 25 mls. Build to an appropriate final volume.

C. **Dissolved Metals**

The filtered sample can be analyzed as received, or evaporated to a lesser volume for concentration purposes.

D. **GFAA Analysis**

HCL acid should not be employed if analysis by GFAA is required.

E. ICP MS Analysis - 6020 M

To a 100 ml aliquot add 2 ml of 1:1 HNO_3 and 1 ml of 1:1 HCl. Reduce the volume to approximately 25 mls. Build to 100 mls.

2. **EXTRACTS**

For extracts (eg: TCLP) reference EPA SW 846 methods (eg: 6010 for ICP). The appropriate method of digestion, which is 3010, should be referenced in a cover letter as well as the method number for the extraction (eg: TCLP-1311, SPLP-1312). This digestion method is, for all intents and purposes, identical to the "total metals" digestion for water samples.

3. **SOIL AND VEGETATION SAMPLES**

For soil analyses, reference EPA SW 846 methods. The method of digestion is 3050 and is summarized below.

A representative 1 to 2 gram sample is digested in 10 mls of 1:1 HNO_3 for 10 to 15 minutes. Cool the sample and add 5 mls concentrated HNO_3 and reflux for 30 minutes. Cool the sample, add 2 mls DI and 3 mls 30% H_2O_2 and heat. Continue adding H_2O_2 in 1 ml aliquots with warming up to a total of 10 mls. For flame AA and ICP, add 10 mls of 1:1 HCL per 100 mls final volume, reflux for 15 more minutes and build to volume (typically 1 gram to 50 mls). For GFAA analysis, do not add the HCL; reduce the sample to approximately 5 mls and build to volume.

cc: GRStanga
VPKeller

Standard Operating Procedure

Hardness - EPA Method 200.7 Ca & Mg

Parameter - Hardness

Range of Measurement - 1 - 1000 mg/L
Range can be extended by sample dilution.

Method Detection Limit - .10mg/l

Sample Matrix - Water and waste water

Principle, Scope & Application - Hardness as determined by calculation from the results of separate determinations of calcium and magnesium. This method applies to the determination of hardness in water at the range specified above.

Interferences & Corrective Actions - Refer to EPA Method 200.7

Sample Size, Collection, Preservation and Handling - Typically hardness is analyzed on an unpreserved sample, for purposes of comparison to the soluble anions, which are also to be analyzed on an unpreserved sample.

Apparatus - Perkin Elmer Model Optima 3000 DV

For: Routine Preventative Maintenance, Reagent & Calibration Standards, Calibration Procedures, Sample Preparation, Analytical Measurement, Procedure, Quality Control Requirements and Method Validation Data:
Reference 1) AMS Document TSC-430-L-PR-010, "Basic Operation and Maintenance of the Perkin Elmer Optima 3000 DV.
2) Standard Operating Procedure For Method 200.7.

Data Treatment - Data is logged out on the LIMS system. A hard copy of the data is kept on file with the analysts copy of the report.
Hardness, Mg equivalent CaCO3/l - 2.497 [Ca, Mg/l] + 4.118 Mg, Mg/l].

Data Deliverables -Standard data deliverables include sample date, date of analysis, method of analysis and the analysts initials. Date of sample receipt is noted in the reporting cover letter. Data deliverables may or may not include quality control summaries and/or raw data dependent upon the clients request.

References -EPA Method 200.7 Ca&Mg.

Standard Operating Procedure

Mercury - EPA Method 245.1

Parameter - Mercury

Range of Measurement - .2 ppb - 5 ppb. Note; range can be extended, changing operating parameters and/or sample dilution.

Method Detection Limit - .03 ppb

Sample Matrix - Aqueous wastes, extracts, ground and surface waters

Principle, Scope & Application - The principle of measurement is cold vapor atomic absorption. This method applies to the analysis of the matrices listed above.

Interferences & Corrective Actions -
1) Potassium permanganate is added to eliminate possible interference from sulfide. Concentrations as high as 20 mg/L of sulfide as sodium sulfide do not interfere with spike recovery.
2) Copper has also been reported to interfere: however, copper concentrations as high as 10 mg/L had no effect on recovery of mercury from spiked samples.
3) Samples high in chlorides require additional permanganate (as much as 25 ml) because, during the oxidation step, chlorides are converted to free chlorine, which also absorbs radiation of 253.6 nm. Care must therefore be taken to ensure that free chlorine is absent before the mercury is reduced and swept into the cell. This may be accomplished by using an excess of hydroxylamine sulfate reagent (25 ml).

Safety Precautions - Mercury is toxic. Standard laboratory protective devices of safety glasses, gloves and lab coats should be utilized to prevent exposure. A tube containing potassium permanganate is utilized at the gas exit port to prevent exposure to mercury vapors.

Sample Size, Collection, Preservation and Handling - In accordance with Methods for Chemical Analysis of Water and Wastes, Chapter 1, the samples are to be acidified with HNO_3 to pH <2 at the time of sample collection. The holding time for mercury is 28 days.

Apparatus - CETAC Model 6000A - Mercury Analyzer

Routine Preventative Maintenance - Refer to ASARCO AMS document #154 section 6.3. Also refer to CETAC M-6000A-Mercury Analyzer Operators Manual.

Reagent & Calibration Standards -
1) Sulfuric acid, (H_2SO_4), concentrated: Reagent grade.
2) Sulfuric acid, 0.5 N: Dilute 14.0 ml of concentrated sulfuric acid to 1.0 liter.
3) Nitric acid (HNO_3), concentrated: Reagent grade of low mercury content.
4) Stannous Chloride: Add 100 g stannous chloride to 100 ml of concentrated HCl.
5) Sodium chloride-hydroxylamine sulfate solution: Dissolve 12 g of sodium chloride and 12 g of hydroxylamine sulfate in type II water and dilute to 100 ml. (Hydroxylamine hydrochloride may be used in place of hydroxylamine sulfate.)
6) Potassium permanganate, mercury-free, 5% solution (w/v): Dissolve 5 g of potassium permanganate in 100 ml of type II water.
7) Potassium persulfate, 5% solution (w/v): Dissolve 5 g of potassium persulfate in 100 ml of type II water.
8) Stock mercury solution: Dissolve 0.1354 g of mercuric chloride in 75 ml of type II water. Add 10 ml of concentrated HNO_3 and adjust the volume to 100.0 ml (1 ml = 1 mg Hg).
9) Mercury working standard: Make successive dilutions of the stock mercury solution to obtain working standards, typically .2, .5, 1.0, 2.0 and 5.0 ppb Hg in 10% HCl.

Calibration Procedures - Calibrations are conducted prior to each analytical run and every 8 hours at a minimum. Routine samples are analyzed with a calibration blank and 5 standards ranging from .2 ppb to 5 ppb.

Sample Preparation - Samples are prepared in accordance with method 245.1 utilizing proportionately reduced volumes of sample and reagents (25 mls sample, 1.25 mls H_2SO_4, .6 mls conc. HNO_3, 4 mls $KMNO_4$, 2 mls potassium persulfate and 2 mls hydroxylamine hydrochloride). Samples are heated at 95 deg. C in a hot water bath for 2 hours prior to the addition of hydroxalamine hydrochloride. Samples are built to a final volume of 50 mls.

Analytical Measurement / Procedure - The samples are placed in autosampler tubes and the analysis proceeds in accordance with the guidelines detailed in accordance with the ASARCO AMS document TSC-430-L-PR-003. This is a continuous flow analyzer with automated addition of stannous chloride.

Procedure - The procedure for analysis is detailed in the ASARCO AMS document "Basic Operation and Maintenance of the CETAC mercury Analyzer - Model 6000A."

Data Treatment - Data is kept on hard disk for one year. A hard copy of the data is kept on file with the analysts copy of the report. Data is logged out for analytical reports on the LIMS system.

Data Deliverables -Standard data deliverables include sample date, date of analysis, method of analysis and the analysts initials. Date of sample receipt is noted in the reporting cover letter. Data deliverables may or may not include quality control summaries and/or raw data dependent upon the clients request.

Quality Control Requirements - In brief, the quality control includes; 1) the following four digestion QC samples- Preparation Blank, Duplicate, Matrix Spike and Laboratory Control Sample and 2) the following run QC; initial and continuing calibration verifications, initial and continuing calibration blanks.

The following table summarizes quality control limits and frequency requirements.

QUALITY CONTROL SAMPLES	FREQUENCY	LIMITS
Prep Blanks	1 per batch of 20 or	< PQL (Practical

	less	Quantitation Limit)
Laboratory Control Sample	1 per batch of 20 or less	85-115%
Duplicate	1 per batch of 20 or less	20% RPD, if <5 X PQL
Spike	1 per batch of 20 or less	75-125%
Initial Calibration Verification	after every calibration	95-105%
Initial Calibration Blank	after every calibration	< CRDL
Continuing Calibration Verification	10%	90-110%
Continuing Calibration Blanks	10%	< PQL

References - EPA Methods for Chemical Analysis of Water and Waste
CETAC ASX-500-Auto Sampler Operators Manual
CETAC M-6000A-Mercury Analyzer Software Manual
CETAC M-6000A-Mercury Analyzer Operators Manual
ASARCO AMS Document-TSC-430-L-PR-003-Basic Operation and Maintenance of the CETAC Mercury Analyzer-Model M6000A

Method Validation Data -Refer to EPA Methods for Chemical Analysis of Water and Waste.

Standard Operating Procedure

Mercury - Method 7470A

Parameter - Mercury

Range of Measurement - .2 ppb - 5 ppb Note; range can be extended, changing operating parameters and/or sample dilution.

Method Detection Limit - .03 ppb

Sample Matrix - Aqueous wastes, extracts, ground and surface waters

Principle, Scope & Application - The principle of measurement is cold vapor atomic absorption. This method applies to the analysis of the matrices listed above.

Interferences & Corrective Actions -
1) Potassium permanganate is added to eliminate possible interference from sulfide. Concentrations as high as 20 mg/L of sulfide as sodium sulfide do not interfere with spike recovery.
2) Copper has also been reported to interfere: however, copper concentrations as high as 10 mg/L had no effect on recovery of mercury from spiked samples.
3) Samples high in chlorides require additional permanganate (as much as 25 ml) because, during the oxidation step, chlorides are converted to free chlorine, which also absorbs radiation of 253.6 nm. Care must therefore be taken to ensure that free chlorine is absent before the mercury is reduced and swept into the cell. This may be accomplished by using an excess of hydroxylamine sulfate reagent (25 ml).

Safety Precautions - Mercury is toxic. Standard laboratory protective devices of safety glasses, gloves and lab coats should be utilized to prevent exposure. A tube containing potassium permanganate is utilized at the gas exit port to prevent exposure to mercury vapors.

Sample Size, Collection, Preservation and Handling - In accordance with SW846, Chapter 3, the samples are to be acidified with HNO3 to pH <2 at the time of sample collection. The holding time for mercury is 28 days.

Apparatus - CETAC Model 6000A - Mercury Analyzer

Routine Preventative Maintenance - Refer to ASARCO AMS document #154 section 6.3. Also refer to CETAC M-6000A-Mercury Analyzer Operators Manual.

Reagent & Calibration Standards -
1) Sulfuric acid, (H2SO4), concentrated: Reagent grade.
2) Sulfuric acid, 0.5 N: Dilute 14.0 ml of concentrated sulfuric acid to 1.0 liter.
3) Nitric acid (HNO3), concentrated: Reagent grade of low mercury content.
4) Stannous Chloride: Add 100 g stannous chloride to 100 ml of concentrated HCl.
5) Sodium chloride-hydroxylamine sulfate solution: Dissolve 12 g of sodium chloride and 12 g of hydroxylamine sulfate in type II water and dilute to 100 ml. (Hydroxylamine hydrochloride may be used in place of hydroxylamine sulfate.)
6) Potassium permanganate, mercury-free, 5% solution (w/v): Dissolve 5 g of potassium permanganate in 100 ml of type II water.
7) Potassium persulfate, 5% solution (w/v): Dissolve 5 g of potassium persulfate in 100 ml of type II water.
8) Stock mercury solution: Dissolve 0.1354 g of mercuric chloride in 75 ml of type II water. Add 10 ml of concentrated HNO3 and adjust the volume to 100.0 ml (1 ml = 1 mg Hg).
9) Mercury working standard: Make successive dilutions of the stock mercury solution to obtain working standards, typically .2, .5, 1.0, 2.0 and 5.0 ppb Hg in 10% HCl.

Calibration Procedures - Calibrations are conducted prior to each analytical run and every 8 hours at a minimum. Routine samples are analyzed with a calibration blank and 5 standards ranging from .2 ppb to 5 ppb.

Sample Preparation - Samples are prepared in accordance with method 7470A utilizing proportionately reduced volumes of sample and reagents (25 mls sample, 1.25 mls H2SO4, .6 mls conc. HNO3, 4 mls KMNO4, 2 mls potassium persulfate and 2 mls hydroxylamine hydrochloride). Samples are heated for 2 hours in a hot water bath at 95 degrees C for 2 hours prior to the addition of hyroxylamine hydrochloride. Samples are built to a final volume of 50 mls.

Analytical Measurement / Procedure - The samples are placed in autosampler tubes and the analysis proceeds in accordance with the guidelines detailed in accordance with the ASARCO AMS document TSC-430-L-PR-003. This is a continuous flow analyzer with automated addition of stannous chloride.

Procedure - The procedure for analysis is detailed in the ASARCO AMS document "Basic Operation and Maintenance of the CETAC mercury Analyzer - Model 6000A."

Data Treatment - Data is kept on hard disk for one year. A hard copy of the data is kept on file with the analysts copy of the report. Data is logged out for analytical reports on the LIMS system.

Data Deliverables -Standard data deliverables include sample date, date of analysis, method of analysis and the analysts initials. Date of sample receipt is noted in the reporting cover letter. Data deliverables may or may not include quality control summaries and/or raw data dependent upon the clients request.

Quality Control Requirements - A detail of quality control for this project can be found in SW846-method 7470A. In brief, the quality control includes; 1) the following four digestion QC samples- Preparation Blank, Duplicate, Matrix Spike and Laboratory Control Sample and 2) the following run QC; initial and continuing calibration verifications, initial and continuing calibration blanks.

The following table summarizes quality control limits and frequency requirements.

QUALITY CONTROL SAMPLES	FREQUENCY	LIMITS
Prep Blanks	1 per batch of 20 or	< PQL (Practical

	less	Quantitation Limit)
Laboratory Control Sample	1 per batch of 20 or less	80-120%
Duplicate	1 per batch of 20 or less	20% RPD, if <5 X PQL
Spike	1 per batch of 20 or less	85-115%
Initial Calibration Verification	after every calibration	90-110%
Initial Calibration Blank	after every calibration	< CRDL
Continuing Calibration Verification	10%	80-120%
Continuing Calibration Blanks	10%	< PQL

References - EPA SW846-Test Methods for Evaluating Solid Waste
CETAC ASX-500-Auto Sampler Operators Manual
CETAC M-6000A-Mercury Analyzer Software Manual
CETAC M-6000A-Mercury Analyzer Operators Manual
ASARCO AMS Document-TSC-430-L-PR-003-Basic Operation and Maintenance of the CETAC Mercury Analyzer-Model M6000A

Method Validation Data -Refer to data SW846 Method 7470A section 9.0-Method Performance.

Standard Operating Procedure
Metals by Method 6010B-Inductively Coupled Plasma-Atomic Emission Spectroscopy

Parameter - Metals and Metalloids

Range of Measurement - Analyte specific

Method Detection Limit - Analyte specific - Refer to current MDL summaries.

Sample Matrix - Digestions of: soils, sediments, TCLP extractions and EP extracts, waters and aqueous samples.

Principle, Scope & Application - The principle of measurement is inductively coupled plasma emission spectroscopy. Refer to method 6010B section 2.2 for a synopsis of the principle. This method applies to the matrices listed above.

Interferences & Corrective Actions - Interferences and the associated corrections are detailed extensively in 1) section 3.0 of method 6010B, 2) "ICP WinLab Software Guide" The Perkin-Elmer Corporation, 1997, 3) ICAP 61E Operators Manual. -Thermo Jarrell Ash Corporation, 4) Basic Operation and Maintenance of the TJA ICAP 61-ASARCO AMS document TSC-430-L-PR-015.

The primary components of interference correction detailed in the references, 1) line selection, 2) off peak background correction, and, 3)interelement correction factors.

Safety Precautions -

1. Switch power to "off" before accessing any circuits.
2. Handle acidified solutions carefully. Address all spills immediately.
3. The instrument's ventilation fan(s) must be operating when the instrument is running.
4. Some components may remain at an elevated temperature long after the plasma has been extinguished.

Sample Size, Collection, Preservation and Handling -

1) Collect samples in accordance with SW846, Chapter 3. 2) Sample size is matrix specific. The final volume of aqueous digestate should be a minimum of 25 mls. 3) The holding time for metals is 6 months. 4) At the time of sampling, the sample must be preserved with nitric acid to pH <2.

Apparatus -Perkin-Elmer 3000 DV

Routine Preventative Maintenance -

1. Clean air filters monthly.
2. Change peristaltic pump tubing when a flat place develops between the wishbones.
3. Clean or change the torch when it is dirty.

Reference AMS Document TSC-430-L-PR-010 for more detail regarding instrument maintenance.

Reagent & Calibration Standards - The rinse solution is 5%, v/v, HCl. The calibration solution(s) used are specific to the analyte(s) of interest. The blank solution is 10%, v/v HCl. Standards we purchase from a commercial vendor. Records of standard dilution and period of use are maintained in an analytical standards log book.

Calibration Procedures - A calibration curve must be prepared each day for each sample run with a minimum of a calibration blank and one standard per analyte of interest. After calibration, the calibration curve must be verified by use of at least a calibration blank and a calibration check standard, (made from a reference material or other independent standard material), at or near the mid-range. The calibration reference must be measured within 10 % of its true value for the curve to be considered valid.

Sample Preparation - Samples are digested in accordance with SW846, chapter 3.

Analytical Measurement - Once the plasma has been established, allow the instrument to warm up under the analytical run conditions for at least an hour. Profile using the mercury lamp and in the case of the Optima, optimize the X and Y alignment of the torch to the optics.

Procedure

1) Select a method.

2) Calibrate and read the standards against the calibration curve.
3) Input the samples of interest, the quality controls and the relevant correction factor into a sample information file.
4) Select the analytical method, the sample information file and the data file for data storage.
5) Start the analytical run and periodically ascertain the quality of the data being generated.

Data Treatment -The data is automatically output to the printer connected to the computer that controls the instrument. Data is kept on hard disk for approximately one week. A hard copy of the data is kept on file with the analyst's copy of the report. Data is logged out for analytical reports on the LIMS system.

Data Deliverables -Standard data deliverables include sample date, date of analysis, method of analysis and the analysts initials. Date of sample receipt is noted in the reporting cover letter. Data deliverables may or may not include quality control summaries and/or raw data dependent upon the clients request.

Quality Control Requirements -In brief, the quality control includes; 1) the following four digestion QC samples - Preparation Blank, Duplicate, Matrix Spike and Laboratory Control Sample and 2) the following run QC; initial and continuing calibration verifications, initial and continuing calibration blanks, contract required detection limit standard, and interferents check samples A and A+B.

The following table summarizes quality control limits and frequency requirements.

QUALITY CONTROL SAMPLES	FREQUENCY	LIMITS
Prep Blanks	1 per batch of 20 or less	< PQL (Practical Quantitation Limit)
Laboratory Control Sample	1 per batch of 20 or less	80-120%
Duplicate	1 per batch of 20 or less	20% RPD, if <5 X PQL

Spike	1 per batch of 20 or less	75-125%
Initial Calibration Verification	after every calibration	90-110%
Initial Calibration **Blank**	after every calibration	< PQL
Continuing Calibration Verification	10%	90-110%
Continuing Calibration **Blanks**	10%	< PQL
Interferents Check Sample A (**ICS A**) Interferents Check Sample A+B **(ICS A+B)**	At the beginning of the first analytical run of the day, at the end of the last analytical run of the day but not less than every 8 hours.	80-120%

<u>**References**</u> -EPA SW846 - Test Methods for Evaluating Solid Waste
ICAP 61 Operator's Manual-Thermo Jarrell Ash Corporation
ICAP 61E Operator's Manual-Thermo Jarrell Ash Corporation
ICAP 61 A General Scheme for Software Usage. Analytical Protocol and Method Development.
Optima 3000 Hardware Guide-The Perkin-Elmer Corporation
ICP WinLab Software Guide-The Perkin-Elmer Corporation
Optima 3000 DV Supplement-The Perkin-Elmer Corporation

<u>**Method Validation Data**</u> -Refer to data SW846 Method 6010B Section 9.0 - Method Performance

Standard Operating Procedure
Metals by Method 6020-Inductively Coupled Plasma-MASS Spectrometry

Parameter - Metals and Metalloids

Range of Measurement - Analyte specific

Method Detection Limit - Analyte specific - Refer to current MDL summaries.

Sample Matrix - Dissolved elements and digestions of: soils, sediments and ground, surface and drinking water.

Principle, Scope & Application - The principle of measurement is inductively coupled plasma Mass spectrometry. Refer to method 6020 section 1.0 for a synopses of the principle. This method applies to the matrices listed above.

Interferences & Corrective Actions - Interferences and the associated corrections are detailed extensively in the following
1) Perkin Elmer SOP "Method 200.8 using Elan 6000",
2) Perkin Elmer SOP "Method 6020 using Elan 6000",
3) EPA Method 6020.

Safety Precautions -
General laboratory safety procedures are followed in the handling of chemical reagents. For more information, refer to EPA Method 200.8 Section 5.0.

Sample Size, Collection, Preservation and Handling -
Samples are collected in accordance with EPA SW 846. The final volume of aqueous digestates should be a minimum of 25 mls. The holding time for metals is six months.

Apparatus -Perkin Elmer Sciex Elan 6000 - Inductively Coupled Plasma-Mass Spectrometer.

Routine Preventative Maintenance - Preventive maintenance is covered extensively in;
1) Perkin Elmer Elan 6000 ICP-MS Service Manual.

2) ASARCO Document #TSC-430-L-PR-018 "Basic Operation and Maintenance of the PE Elan 6000 ICP-MS".

Reagent & Calibration Standards -
Calibration standard - Spex Claritas Instrument Calibration Standard 2
Quality Control Sample - Spex Claritas Instrument Check Standard 1
Internal Standard - Spex Claritas Multi-element Internal Standard
Acids - J.T. Baker Instra-Analyzed©

Calibration Procedures - Standards are analyzed at the beginning of daily analysis, when sample matrices change or when sample sensitivity increases or decreases at a level to interfere with analysis.

Standard Concentrations:	0 ppb
	10 ppb
	20 ppb
	200 ppb

Sample Preparation - For sample preparation refer to EPA SW 846.

The internal standard is added to all standards, quality control and samples in accordance with EPA Method 6020.

Analytical Measurement & Procedure -
For comprehensive instructions, refer to ASARCO AMS Document #TSC-430-L-PR-018.
"Basic Operation and Maintenance of the PE Elan 6000 ICP-MS"

Listed below is a summary
1) Tune the instrument
2) Perform a daily performance analysis to confirm that instrument performance is within specifications.
3) Calibrate the instrument
4) Start the analysis of the samples and associated quality control.

Data Treatment -The PE Elan 6000 has several report options. A general summary report is used for all analyses unless another type of report is requested. The report is delivered to the project chemist who was assigned the samples. Data is logged out on the LIMS system.

6020

Data Deliverables -Standard data deliverables include sample date, date of analysis, method of analysis and the analysts initials. Date of sample receipt is noted in the reporting cover letter. Data deliverables may or may not include quality control summaries and/or raw data dependent upon the clients request.

Quality Control Requirements - The quality control includes; 1) the following four digestion QC samples - Preparation Blank, Duplicate, Matrix Spike and Laboratory Control Sample and 2) the following run QC; initial and continuing calibration verifications, initial and continuing calibration blanks.

The following table summarizes quality control limits and frequency requirements.

QUALITY CONTROL SAMPLES	FREQUENCY	LIMITS
Prep Blanks	1 per batch of 20 or less	< PQL (Practical Quantitation Limit)
Laboratory Control Sample	1 per batch of 20 or less	80-120%
Duplicate	1 per batch of 20 or less	20% RPD, if <5 X PQL
Spike	1 per batch of 20 or less	75-125%
Initial Calibration Verification	after every calibration	90-110%
Initial Calibration Blank	after every calibration	< PQL
Continuing Calibration Verification	10%	90-110%
Continuing Calibration Blanks	10%	< PQL
Internal Standards	All inclusive	30-120%

6020

Interference Check Standards A+B	Beginning of an analytical run or once ever 12 hrs.	None listed
Serial Dilution	1 per batch of 20 or less	± 10% of the undiluted sample value

References -EPA Methods for Chemical Analysis of Water and Waste
Perkin Elmer SOP "Method 200.8 Using Elan 6000"
Perkin Elmer SOP "Method 6020 Using Elan 6000"
EPA Method 6020
Perkin Elmer Elan 6000 ICP-MS Service Manual
ASARCO AMS Document #TSC-430-L-PR-018 - "Basic Operation and Maintenance of the PE Elan 6000 ICP-MS

Method Validation Data -Refer to Method 6020 Section 9.0 Tables 1-5.

Standard Operating Procedure
Orthophosphate in Water - EPA Method 365.1

Parameter - Orthophosphate

Range of Measurement - .10 - 1.5 ppm

Method Detection Limit - .005 ppm calculation in accordance with 40CFX part 136, Appendix B.

Sample Matrix - water

Principle, Scope & Application - This method is used for the determination of orthophosphate in drinking, surface and saline waters, domestic and industrial wastes. The applicable range of this method is 0.10 to 1.5 mg/L P. The range may be extended by changing the detector sensitivity or by sample dilution.

Orthophosphate reacts with molybdenum (VI) and antimony (III) in an acid medium to form an antimony-phosphomolybdate complex. This complex is subsequently reduced with ascorbic acid to form a blue color and the absorbance is measured at 660nm.

Interferences & Corrective Actions - Ferric iron up to 50 mg/L copper, up to 10 mg/L do not interfere. Filter turbid samples prior to analysis. Samples with background absorbance at the analytical wavelength may interfere.

Safety Precautions - Refer to MSDS's for Ammonium Molybdate, Antimony Potassium Tartrate, Ascorbic Acid, Potassium Dihydrogen Phosphate, Sulfuric Acid, concentrated. Standard protective devices are to be utilized (safety glasses, lab coats, gloves and vent hood).

Sample Size, Collection, Preservation and Handling - Determine orthophosphate in unpreserved samples immediately after they are collected. Unpreserved samples may be held for 48 hours when cooled immediately and stored at 4°C. Filter turbid samples prior to analysis.

Apparatus - Alpkem model 3590 automated colorimetric segmented flow analyzer

Routine Preventative Maintenance - Ascorbic Acid Stock Solution-Check color of the ascorbic acid reagent. It should be clear liquid, colorless to light amber in color; a darker color indicates poor reagent quality or aged solution. Either remake solution or change to new source of ascorbic acid.

When changing the sample pump tube, it is important to cut the tube close to the collars before reconnecting the transmission tubing. This helps prevent carryover.

When starting up, let system run on deionized water with 2.0 ml/L DowFax 2A1 for 10-15 minutes. Add the color reagent and wait for a stable baseline. The pH from the flowcell waste line, should approximate pH 1 when checked with pH paper.

If baseline is noisy, check:
1) Color of ascorbic acid stock solution.
2) Reagents should be filtered prior to use through a 0.45μ membrane filter.

Carryover can be solved by washing out entire system with a 1.0N sodium hydroxide solution for 5 minutes. For consistent results, flush system out every day before use and increase the sampler wash time.

Reagent & Calibration Standards-
1. DowFax Start-Up Solution (1L)
To a 1L volumetric flask containing 800 ml deionized water, add 2 ml of DowFax 2A1. Dilute to 1.000 ml with deionized water.
2. Stock Sulfuric Acid, 5N (1L)
Add 140 ml of concentrated sulfuric acid (FW 98.08) to 800 ml of deionized water contained in a 1L volumetric flask. Cool and dilute to 1,000 ml with deionized water.
3.Stock Antimony Potassium Tartrate Solution (1L)
Dissolve 3.0 g of antimony potassium tartrate (FW 333.94) in 500 ml of deionized water contained in a 1L volumetric flask. Dilute to 1000 ml with deionized water. Store at 4°C in a dark bottle.
4. Stock Ammonium Molybdate Solution (1L)

Dissolve 40 g of ammonium molybdate (FW 1235.95) in 800 ml of deionized water contained in a 1 L volumetric flask. Dilute to 1000 ml with deionized water. Store at 4 °C in a polyethylene bottle.

5. Stock Ascorbic Acid Solution (1L)

Dissolve 18 g of ascorbic acid (FW 176.13) in 700 ml of deionized water contained in a 1 L volumetric flask. Dilute to 1.000 ml with deionized water. This solution is stable for one week if stored at 4 °C.

6. Stock Sulfuric Acid, 5N (1L)

Cautiously add 140 ml of concentrated sulfuric acid (FW 98.08) to 800 ml of deionized water contained in a 1 L volumetric flask. Cook to room temperature and dilute to 1000 ml with deionized water.

7. Stock Antimony Potassium Tartrate Solution (1L)

Dissolve 3.0 g of antimony potassium tartrate (FW 333.94) in 500 ml of deionized water contained in a 1 L Volumetric flask. Dilute to 1000 ml with deionized water. Store at 4 °C in a dark bottle.

8. Stock ammonium Molybdate Solution (1L)

Dissolve 40 g of ammonium molybdate (FW 1235.95) in 800 ml of deionized water contained in a 1 L volumetric flask. Dilute to 1000 ml with deionized water. Store at 4 °C in a polyethylene bottle.

9. Stock Ascorbic Acid Solution (1L)

Dissolve 18 g of ascorbic acid (FW 176.13) in 700 ml of deionized water contained in a 1 L volumetric flask. Dilute to 1000 ml with deionized water. This solution is stable for one week if stored at 4 °C.

10. Color Reagent (200 ml)

    100 ml Stock Sulfuric Acid, 5N
    10 ml Stock Antimony Potassium Tartrate Solution
    30 ml Stock Ammonium Molybdate Solution
    60 ml Stock Ascorbic Acid Solution

Add reagents in the order stated and mix after each addition. This will prevent the ascorbic acid from turning a darker color when the solution is first made. Prepare reagent daily.

The stock calibrant is a 1000 mg/l from 4.393 g of dry potassium dihydrogen phosphate (FW 136.09) diluted to 1 liter with deionized water. Serial dilutions are made for standards at .10, .20, .50, 1.0 and 1.5 ppm.

Calibration Procedures - A calibration curve must be prepared for each sample run with a minimum of calibration blank and .10, .20, .50, 1.0 and 1.5 ppm standards. After calibration, the calibration curve must be verified by use of at least a calibration blank and a calibration check standard (made from a reference material or other independent standard material) at or near the mid-range. The calibration reference must be measured within 10% of it's true value for the curve to be considered valid.

Sample Preparation - Samples are allowed to equilibrate to room temperature prior to analysis. Turbid samples are filtered prior to analysis.

Analytical Measurement - The detector 510 and sampler 501 should be adjusted according to the instructions on page 15 of the Orthophosphate section of the manual. To set up the 502b pump turn to page 14. Note; the helper line (black/black) is not used in this run. Attach the sample line #5 directly to 501 sampler line.
Turn to page 7 (paragraphs 3-7) for Operating Procedure
NOTE: The reagent is always made fresh
The heater is set to 37 degrees Celsius.
The surfactant solution for orthophosphate is DowFax.

The settings on the 510 detector should be the following; page 15

-wavelength	660;
-range	0.2 AUFS;
-rise time	3.0 sec

The settings on the 501 sampler should be the following; page 15

-sample time	15 sec
-wash time	55 sec
-pecking	off

If the Sync (highest standard) check is good, you can start the sampler run at this time.
Press **Esc** once
Press **Alt** and **#1** simultaneously, then press **Enter**, followed by **Y**.
Press **F3** which allows for monitoring and observing the analytical run.

Procedure -
-Set up manifold
-Pump Reagents until a stable baseline is obtained
-Construct calibration curve
-Analyze samples in accordance with the analytical measurement section of this document

Data Treatment - A computer data printout is obtained from the Alpkem 3590 system. This includes calibration curves, correlation coefficients, concentrations and associated intensities. Data is logged out on the LIMS system. A hard copy of the data is kept on file with the analysts copy of the report.

Data Deliverables - Standard data deliverables include sample date, date of analyses, method of analysis and the analysts initials. Date of sample receipt is noted in the reporting cover letter. Data deliverables may or may not include quality control summaries and/or raw data, dependent o\upon the clients request.

Quality Control Requirements - The quality control includes; 1) the following four QC samples - Preparation Blank, Duplicate, Matrix Spike and Laboratory Control Sample and 2) the following run QC; initial and continuing calibration verifications, initial and continuing calibration blanks.

The following table summarizes quality control limits and frequency requirements.

QUALITY CONTROL SAMPLES	FREQUENCY	LIMITS
Prep Blanks	1 per batch of 20 or less	< PQL (Practical Quantitation Limit)
Laboratory Control Sample	1 per batch of 20 or less	80-120%
Duplicate	1 per batch of 20 or less	20% RPD, if <5 X PQL
Spike	1 per batch of 20 or less	75-125%
Initial Calibration Verification	after every calibration	90-110%
Initial Calibration Blank	after every calibration	< PQL

Continuing Calibration Verification	10%	90-110%
Continuing Calibration Blanks	10%	< PQL

References - Enviroflow 3500 Technical Information
Perstorp Operators Manual.
The Flow Solution Operation Manual - Alpekm/Perstorp
Analytical SoftPac (tm) Plus Manual-Perstorp
Analytical
EPA Method 365.1

Method Validation Data -Refer to EPA Method 375.2 of Methods for Chemical Analysis of Water and Wastes.

Latest Revision 1/6/99

Standard Operating Procedure

pH in Water - EPA Method 150.1

Parameter - pH

Principle, Scope & Application - The pH of a sample is determined electrometrically using a combination electrode. This method is applicable to drinking, surface, and saline waters, domestic and industrial wastes.

Interferences & Corrective Actions - Coatings of oily material or particulate matter can impair electrode response. The corrective action is to clean the electrode. Temperature affects pH and is corrected for by temperature compensation.

Sample Size, Collection, Preservation and Handling - pH should be conducted on samples in the field at the time of sampling. Laboratory measurements, include notification of the aforementioned and are performed as soon as possible on an unpreserved sample.

Apparatus -
pH electrode
pH meter - Corning Model 130
Magnetic stirrer and teflon coated stirring bar

Routine Preventative Maintenance - Refer to pH electrode instruction manual.

Reagent & Calibration Standards
Commercially purchased standard pH buffer solution at pH 4.0, 7.0 and 10.0.

Calibration Procedures - Calibrate at a minimum of 2 points that bracket the expected pH of the samples and are 3 pH units apart. Repeat the adjustments in successive portions of the two buffer solutions until readings are within .05 pH units of the buffer solution value.

Sample Preparation - No sample preparation is required.

Analytical Measurement/Procedure -
Equilibrate buffer solutions and samples to within 2°C of each other. If the temperature differences are > 2°C, measure the temperature of the sample and utilize the temperature compensation dial of the pH meter. Transfer approximately 100 mls of sample to 150 ml beaker on a magnetic stirrer with teflon stirring bar. Rate of stirring should minimize the air transfer rate to the sample. Record the pH. Repeat the measurement until values differ by less than .1 pH unit.

Data Treatment -The Corning Model 130 does not have a data printout. Data is recorded in the laboratory notebooks, utilizing standard practices, (i.e. Each page is dated and initialed. Entries are in ink. Corrections are made with a single line through, dated and initialed). Data is logged out on the LIMS system. A hard copy of the data is kept on file with the analysts copy of the report.

Data Deliverables -Standard data deliverables include sample date, date of analysis, method of analysis and the analysts initials. Date of sample receipt is noted in the reporting cover letter. Data deliverables may or may not include quality control summaries and/or raw data dependent upon the clients request.

Quality Control Requirements -
An outside source standard reference material is analyzed with each batch. The standard limits are the 95% confidence interval.

References -EPA Methods For Chemical Analysis of Water and Wastes Method 150.1.

Method Validation Data -Refer to EPA Method 150.1

Latest Revision 1/11/99

Standard Operating Procedure

Specific Conductance in Water - EPA Method 120.1

Parameter - Conductivity

Principle, Scope & Application - The specific conductance of a sample is measured by use of a self contained conductivity meter. Results reflect conductivity at 25°C. This method is applicable to drinking, surface, and saline waters, domestic and industrial wastes.

Interferences & Corrective Actions - Samples are preferably analyzed at 25°C. Automatic temperature compensation is a function of the Orion Model 160 meter if the samples are not at 25°C.

Sample Size, Collection, Preservation and Handling -A minimum of 100 mls is preferable. Unpreserved samples are stored at 4°C until the time of analysis. The holding time for conductivity is 28 days.

Apparatus -
Conductivity Meter - Orion Model 160

Routine Preventative Maintenance - Refer to the Orion Model 160 instruction manual.

Sample Preparation - Allow the samples to equilibrate to 25°C if possible.

Analytical Measurement/Procedure -
After immersing the conductivity cell into a sample, the Model 160 shows the conductivity OF THAT SAMPLE.

For measurements in "natural waters" (e.g. drinking water, ground water and surface water) with the 015010 conductivity cell, the 160 is already adjusted (e.g. TC=nLF. C=0.609/cm). For ultrapure water, use the 014016 conductivity cell and adjust the cell constant. For other samples (e.g., acids, alkalies and salt solutions) adjust the temperature coefficient (TC) and in case of special conductivity cells, adjust cell constant (C).

NOTE: If either the meter or cell maximum measuring range is exceeded, "OFL" will be displayed.

NOTE: Set the reference temperature to the appropriate setting for your application: 25°C

Data Treatment -The Orion Model 160 does not have a data printout. Data is recorded in the laboratory notebooks, utilizing standard practices, (i.e. Each page is dated and initialed. Entries are in ink. Corrections are made with a single line through, dated and initialed). Data is logged out on the LIMS system. A hard copy of the data is kept on file with the analysts copy of the report.

Data Deliverables -Standard data deliverables include sample date, date of analysis, method of analysis and the analysts initials. Date of sample receipt is noted in the reporting cover letter. Data deliverables may or may not include quality control summaries and/or raw data dependent upon the clients request.

Quality Control Requirements -
An outside source standard reference material is analyzed with each batch. The standard limits are the 95% confidence interval.

References -EPA Methods For Chemical Analysis of Water and Wastes Method 120.1.
Orion Model 160 Conductivity Meter Manual.

Method Validation Data -Refer to EPA Method 120.1

Standard Operating Procedure

Sulfate in Water - EPA SW846 9036-

Parameter - Sulfate

Range of Measurement - 2.0 - 80. ppm

Method Detection Limit - .73 ppm calculated in accordance with 40CFX part 136, Appendix B.

Sample Matrix - Water

Principle, Scope & Application - The sample is first passed through a sodium form cation-exchange column to remove multivalent metal ions. The sample containing sulfate is then reacted with an alcohol solution of barium chloride and methyl thymol blue (MTB) at a pH of 2.5-3.0 to form barium sulfate. The combined solution is raised to a pH of 12.5-13.0 so that excess barium reacts with MTB. The uncomplexed MTB color is gray; if it is all chelated with barium, the color is blue. Initially, the barium and MTB are equimolar and equivalent to 300 mg SO_4/1; thus the amount of uncomplexed MTB is equal to the sulfate present.

Interferences & Corrective Actions - The ion exchange column eliminates interferences from multivalent cations. A fresh column is made prior to a daily run. Samples below pH 2 are neutralized to prevent elution of cations from the ion exchange resin. Turbid samples are filtered.

Safety Precautions -
Refer to MSDS's for barium chloride, sodium hydroxide and ammonium hydroxide. Standard laboratory protective devices are to be utilized (safety glasses, lab coats and gloves).

Sample Size, Collection, Preservation and Handling - Samples are unpreserved and refrigerated at 4° C. The holding time for sulfate is 28 days.

Apparatus - Alpkem model 3590 automated colorimetric segmented flow analyzer.

Routine Preventative Maintenance -
Carefully read information on page 11 of the Alpkem Flow Solution Operation Manual.
MTB reagent has a life span of 3 days. If your run malfunctions prior to that time focus on repacking the column and cleaning the system with buffered EDTA (page 5).
Sulfate cartridge has to be cleaned often due to Barium Sulfate precipitation and if necessary, use the syringe directly on the cartridge holes to force the buffer through the system at high pressure to clean up the clogged mass.
High carryover, loss of sensitivity immediately after calibration curve is run or a clog in the cartridge (indicated by sporadic, slow or whimsical solution flow) is usually an indication that the system must be cleaned; the cation exchange resin must be replaced, or the frit+ ferrule (filter that covers the ion exchange column) must be cleaned or replaced. If the filter is dirty it can cause a clog in the flow of reagents through the system and will result in an extreme decrease in sensitivity.
Replace the cation exchange column resin, making sure there is no air bubbles trapped in the column. **Note: page 12, paragraph 10. The installation of the column is done with 502 pump running**.
Once weekly clean the ferrule with the frit by cleaning it in buffered EDTA cleaning solution and placing the buffer solution with the frit+ferrule in sonicator for 20 minutes.

Reagent & Calibration Standards -
a. Stock Barium Chloride: Dissolve 1.526g of Barium Chloride (FW 244.28) in 1000 ml deionized water.
b. Methylthymol Blue Reagent: Dissolve .188g of MTB (FW 866.73) in 25 ml of stock barium chloride solution. Add 71ml deionized water and 4ml of 1N hydrochloric acid. Dilute to 500ml with ethanol 3A, anhydrous (FW 46.07). Mix this solution vigorously for 1hr of until it is thoroughly degassed. Filter the solution through .45 micrometer membrane filter. Add 2.5ml Brij-35 (30 %). Store in amber bottle.
c. .18N Sodium Hydroxide: Add 9ml of 10N sodium hydroxide (40g NaOH to 100ml, FW 40.0) to 80ml of deionized water contained in a 500ml volumetric flask. Bring to volume of 500ml with deionized water.

d. Diluent: Dilute .375ml of 1000ppm sulfate standard to 1L with deionized water. Add 4 drops Brij-35 (30%).
e. Buffer pH 10.5: Dissolve 6.75g of ammonium chloride (FW 53.5) in 800ml deionized water, add 57ml ammonium hydroxide (FW 35.05), and dilute to 1000ml with deionized water.
f. Cleaning solution, Buffered EDTA, 4%: Dissolve 40g of EDTA in 800ml of pH 10.5 buffer contained in a 1L volumetric flask. Dilute the solution to 1000ml with buffer.
The stock calibrant is a 1000 mg/l solution from 1.4787 g sodium sulfate diluted to 1 liter with deionized water. Serial dilutions are made for standards at 2, 4, 10, 20, 40, 60 and 80 ppm.

Calibration Procedures - A calibration curve must be prepared each day for each sample run with a minimum of a calibration blank and 2, 4, 10, 20, 60 and 80 ppm standards. After calibration, the calibration curve must be verified by use of at least a calibration blank and a calibration check standard (made from a reference material or other independent standard material) at or near the mid-range. The calibration reference must be measured within 10% of it's true value for the curve to be considered valid.

Sample Preparation - Samples are allowed to equilibrate to room temperature prior to analysis. Samples below pH 2 are neutralized. Turbid samples are filtered prior to analysis.

Analytical Measurement - SETTING UP THE RUN ON THE SAMPLER:
F3 allows for correlation between software and **501** sampler. Wash/sample times should be set at 25/85 accordingly. Vial type on **501** sampler is always set at **2**, stop count is always set at **001**.
The analyst should consult the Enviroflow 3500 on page 17 at this time.
The Detector **510** and Sampler **501** should be adjusted according to the instructions on page 17.
To set up the **502b** pump turn to page 16. **Hint: Distinguish the 3 waste lines first and lay them over the 510 detector. This will allow you to set up the rest of the pump lines without confusion. Always set up in this order:** Wash line (green), helper line (black), sample line (#4), Air line (#3), the rest of the lines, followed by setting up the three waste lines in direction counter to the pull of the pump.

The surfactant solution is 35% Brij solution.
Turn to page 8 for Operating procedure. Read page 11 for additional troubleshooting information.

BEGIN ANALYSIS:

If the reagents and column have been installed, press **ZERO** button on the **510** detector to ensure your baseline is equalized. You can begin analysis.

Press **Esc** which returns you to the main menu screen.

Press **F5** and then **F3**. You will check the peak of you highest standard (Sync) at this time in order to see if your range setting on the **510** detector is correct. Press **START** button on the **501** sampler. Observe the peak height on the computer screen and adjust range on the **510** detector accordingly. If the peak is too high, lower the range to 1.0 setting. If the peak is too low, increase the range to the 0.2 setting.

Other setting on the **510** detector should be the following: page 17

-wavelength	460
-range	0.5 AUFS / .20 AUFS
-rise time	10 sec.

The settings on the **501** sampler should be the following: page 17

-sample time	25 sec. / 20
-wash time	85 sec. / 75
-pecking	on (peck cycle button located on back of sampler **501**)

If the Sync (highest standard) check is good you can start the sampler run at this time.

Press **Esc** once

Press **Alt** and **#1** simultaneously, then press **Enter**, followed by **Y**

Press **F3** which allows for monitoring and observing the analytical run.

Procedure

- Set up manifold.
- Prepare ion exchange column
- Allow 30 minute warm up and pump reagents until a stable baseline is achieved.
- Construct calibration curve
- Analyze samples in accordance with the analytical measurement section of this document.

Data Treatment -A computer data printout is obtained from the Alpkem 3590 system. This includes calibration curves, correlation coefficients, concentrations and associated intensities. Data is logged out on the LIMS system. A hard copy of the data is kept on file with the analysts copy of the report.

Data Deliverables -Standard data deliverables include sample date, date of analysis, method of analysis and the analysts initials. Date of sample receipt is noted in the reporting cover letter. Data deliverables may or may not include quality control summaries and/or raw data dependent upon the clients request.

Quality Control Requirements -In brief, the quality control includes; 1) the following four QC samples - Preparation Blank, Duplicate, Matrix Spike and Laboratory Control Sample and 2) the following run QC; initial and continuing calibration verifications, initial and continuing calibration blanks.

The following table summarizes quality control limits and frequency requirements.

QUALITY CONTROL SAMPLES	FREQUENCY	LIMITS
Prep Blanks	1 per batch of 20 or less	< PQL (Practical Quantitation Limit)
Laboratory Control Sample	1 per batch of 20 or less	80-120%
Duplicate	1 per batch of 20 or less	20% RPD, if <5 X PQL
Spike	1 per batch of 20 or less	75-125%
Initial Calibration Verification	after every calibration	90-110%
Initial Calibration Blank	after every calibration	< PQL
Continuing Calibration Verification	10%	90-110%

Continuing Calibration Blanks	10%	< PQL

References -Enviroflow 3500 Technical Information Perstorp Operators Manual.
The Flow Solution Operation Manual - Alpkem/Perstorp Analytical SoftPac (tm) Plus Manual- Perstorp Analytical
EPA SW846 Test Methods For Evaluating Solid Waste - method 9036

Method Validation Data -Refer to EPA Method 375.2 of Methods for Chemical Analysis of Water and Wastes.

Standard Operating Procedure

Total Dissolved Solids - EPA 160.1

Parameter - Total Dissolved Solids - (TDS)

Range of Measurement - 10 mg/1 to 20,000 mg/l

Method Detection Limit - 7.95 mg/liter. Calculated in accordance with 40 CFR part 136, Appendix B.

Sample Matrix - Water

Principle, Scope & Application - A well mixed sample is filtered through a 0.45 micron filter. The filtrate is evaporated and dried to a constant weight at 180° C.
This method applies to drinking, surface and saline waters, domestic and industrial wastes.

Interferences & Corrective Actions - Samples high in dissolved solids may cause a positive interference.

Safety Precautions - Standard laboratory protective devices are to be utilized (safety glasses, lab coats and gloves).

Sample Size, Collection, Preservation and Handling - Samples are unpreserved and refrigerated at 4° C. Analysis should begin as soon as possible and within seven days of sample collection.

Apparatus - 0.45 micron syringe filters
Disposable 60 ml polyethylene syringes
Graduated cylinder
60 ml porcelain or platinum evaporating dishes
Drying oven, 180° C ± 2° C.
Analytical balance capable of weighing .01 mg.
Desiccator

Routine Preventative Maintenance - Calibrate drying oven thermometer against NBS certified thermometer every six months.
Annual calibration and servicing of analytical balance by certified technician.

Reagent & Calibration Standards - NBS traceable thermometer.
Class "S" certified traceable weights.

Calibration Procedures - In addition to the annual calibration of the analytical balance, it is checked weekly against a certified weight and recorded in balance log book.

Sample Preparation - Evaporation dishes are cleaned in hot dilute hydrochloric acid, followed by hot deionized water rinses and dried in oven at 180° C ± 2° C for one hour. Alternatively they are dried in a Bunsen burner flame. Dishes are stored in a desiccator until needed and weighed immediately before use.

Analytical Measurement - Filter an appropriate aliquot (25 to 50 mls) through a 0.45 micron filter into a pre-weighed evaporating dish. Bring to dryness in a drying oven at 90 to 100° C. Elevate the temperature to 180° C ± 2° C for one hour. Cool in a desiccator and weigh. Repeat drying cycle until constant weight is obtained or weight loss is less than 0.5 mg.

Procedure
- Filter sample
-Place measured aliquot in pre-weighed evaporating dish
-Dry sample
-Elevate temperature to 180° C for one hour
-Desiccate sample
-Weigh sample

Data Treatment -Calculate TDS as follows:

$$\text{TDS, mg/l} = \frac{(A - B) \times 1{,}000}{C}$$

where:
A=weight of dried residue + dish in mg

B=weight of dish in mg
C=volume of sample used in ml.
The Mettler AT61 analytical balance is connected to a personal computer and weights and volumes are recorded on a hardcopy printout. Data is stored in the balance room and a hard copy is also kept on file with the analysts copy of the report. Data is logged out on a LIM's system.

Data Deliverables -Data deliverables for this project include all raw data. Results are reported in standard CLP format including all associated FORM I's and all associated quality control data.

Quality Control Requirements -Quality control includes a preparation blank, duplicate and standard reference material. Frequency is 1 per 20 samples.

References - Methods for Chemical Analysis of Water and Wastes.

Method Validation Data -Refer to Methods for Chemical Analysis of Water and Wastes.

Standard Operating Procedure

Total Suspended Solids - EPA 160.2

Parameter - TSS

Range of Measurement - 1.0 - 20,000 mg/liter

Method Detection Limit - .61 mg/liter. Calculated in accordance with 40 CFR part 136, Appendix B.

Sample Matrix - Water

Principle, Scope & Application - A well mixed sample is filtered through a 0.45 micron filter and the residue retained on the filter is dried to constant weight at 103-105° C.

Interferences & Corrective Actions - Samples high in dissolved solids may cause a positive interference. Pre-washing the filter of dissolved solids will minimize this potential interference.

Safety Precautions - Standard laboratory protective devices are to be utilized (safety glasses, lab coats and gloves).

Sample Size, Collection, Preservation and Handling - Samples are unpreserved and refrigerated at 4° C. Analysis should begin as soon as possible and within seven days of sample collection.

Apparatus - Sartorius brand cellulose nitrate filter - .45 micron pore size.
Filtering apparatus with reservoir and disc support.
Suction flask and vacuum pump
Drying oven
Desiccator
Analytical balance capable of weighing .01 mg.

Routine Preventative Maintenance -
Utilize and empty water trap prior to vacuum pump. Calibrate drying oven thermometer against NBS certified thermometer every six months.
Annual calibration and servicing of analytical balance by certified technician.

Reagent & Calibration Standards - NBS traceable thermometer.
Class "S" certified traceable weights.

Calibration Procedures - In addition to the annual calibration of the analytical balance, it is checked weekly against a certified weight and recorded in balance log book.

Sample Preparation - PREPARATION OF THE FILTER:
Place the filter in the filtration apparatus and wash with approximately 20 mls of 3% nitric acid.
Wash with three successive 80 ml volumes of deionized water. Remove all traces of water with vacuum. Remove filter and dry in oven at 103-105° C for one hour. Remove to desiccator and store until needed. Repeat drying cycle until constant weight is achieved. Always handle filters with tweezers.

Analytical Measurement - Selection of sample volumes. 250 mls are typically utilized for the lowest achievable limit of detection. A smaller volume may be required for sample high in particulate.
Assemble the filtering apparatus and begin suction. Wet the filter with a small volume of distilled water to seat it against fitted support.
Shake the sample vigorously and quantitatively transfer an appropriate volume to the filter using a graduated cylinder. Remove all traces of water by continuing to apply vacuum after water has passed through. With suction on, wash the graduated cylinder, filter, non-filterable residue and filter funnel wall with three portions of deionized water allowing complete drainage between washing. Remove all traces of water by continuing to apply vacuum after water has passed through. Carefully remove the filter from the filter support. Dry for one hour at 103-105° C. Cool in a dedicator and weigh. Repeat the drying cycle until a constant weight is obtained.

Procedure

- Pretreat, dry, desiccate and weigh filters
- Vacuum filter an appropriate aliquot
-Rinse apparatus and filter
-Dry, desiccate and re-weigh filter

Data Treatment -Calculate TSS as follows:

$$\text{TSS, mg/l} = \frac{(A - B) \times 1{,}000}{C}$$

where:
A=weight of filter (or filter and crucible) + residue in mg
B=weight of filter (or filter and crucible) in mg
C=ml of sample filtered
The Mettler AT61 analytical balance is connected to a PC and weights and volumes are recorded on a hardcopy printout. Data is stored in the balance room and a hard copy is also kept on file with the analysts copy of the report. Data is logged out on a LIM's system.

Data Deliverables -Data deliverables for this project include all raw data. Results are reported in standard CLP format including all associated FORM I's and all associated quality control data.

Quality Control Requirements -Quality control includes a preparation blank, duplicate and standard reference material, at a frequency of 1 per 20.

References - Methods for Chemical Analysis of Water and Wastes.

Method Validation Data -Refer to Methods for Chemical Analysis of Water and Wastes.

Standard Operating Procedure
Total Phosphorus in Water - EPA Method 365.4

Parameter - Total Phosphorus, (TP)

Range of Measurement - .20 - 2.0 ppm

Method Detection Limit - .023 ppm calculation in accordance with 40CFX part 136, Appendix B.

Sample Matrix - Water

Principle, Scope & Application - This method is used for the determination of total phosphorus in drinking, surface and saline waters, domestic and industrial wastes. The applicable range of this method is 0.2 to 2.0 mgP/L. The range may be extended by changing the detector sensitivity or by sample dilution.

Prior to analysis, samples are digested to hydrolyze phosphorus to orthophosphate. The acidic digestate is neutralized and analyzed for orthophosphate.

Orthophosphate reacts with molybdenum (VI) and antimony (III) in an acid medium to form an antimony-phosphomolybdate complex. This complex is subsequently reduced with ascorbic acid to form a blue color and the absorbance is measured at 660nm.

Interferences & Corrective Actions - Ferric iron up to 50 mg/L copper, up to 10 mg/L do not interfere. Filter turbid samples prior to analysis. Samples with background absorbance at the analytical wavelength may interfere.

Safety Precautions - Refer to MSDS's for Ammonium Molybdate, Antimony Potassium Tartrate, Ascorbic Acid, Chloroform, Potassium Dihydrogen Phosphate, Potassium Sulfate, Red Mercuric Oxide, Sulfuric Acid, concentrated. Standard protective devices are to be utilized (safety glasses, lab coats, gloves and vent hood).

<u>Sample Size, Collection, Preservation and Handling</u> - Determine total phosphorus in unpreserved samples immediately after they are collected. Unpreserved samples may be held for 48 hours when cooled immediately and stored at 4°C. Samples may be preserved by the addition of 2 ml concentrated sulfuric acid per liter of sample and cooled immediately. The holding time for acid preserved samples is 28 days.

<u>Apparatus</u> - Alpkem model 3590 automated colorimetric segmented flow analyzer

<u>Routine Preventative Maintenance</u> - When starting up, let the system run on deionized water with 0.5 ml/l Dowfax 2A1 for 10-15 minutes. Add all reagents on-line except for the molybdate/antimony solution, run 5 minutes more, then add. If precipitation occurs, check the pH from the flowcell waste line, (pH should approximate 1 when checked with pH paper).

If a high background or blank values are observed, carefully evaluate the source of water, cleaning procedure for the digestion glassware, and laboratory environment.

Problem carryover can be solved by washing out entire system with a 1.0N sodium hydroxide solution for 5 minutes. For consistent results, flush system out every day before use and whenever needed. For persistent carryover problems, add a wash cup between every sample using a blank, or increase the sampler wash time.

Reagents should be filtered prior to use through a 0.45 micron membrane filter.

4% Sulfuric Acid - The sampler wash and reagent sulfuric acid solution should be made up as a single lot. When samples are digested prior to analysis, deionized water blanks should also be digested.

<u>Reagent & Calibration Standards-</u>
Refer to Enviroflow 3500 Technical Informant Perstorp Operators Manual, (Total Phosphorus Section-Page 3-5)

The stock calibrant is a 1000 mg/l solution from 4.394 g of dry potassium dihydrogen phosphate (FW 136.09), diluted to 1 liter with deionized water. Preserve with 2 drops of chloroform (FW 119.38). Refrigerate at 2-6°C.

Calibration Procedures - A calibration curve must be prepared for each sample run with a minimum of a digested calibration blank and .20, .40, 1.0, 1.4 and 2.0 ppm digested standards. After calibration, the calibration curve must be verified by use of at least a calibration blank and a calibration check standard (made from a reference material or other independent standard material) at or near the mid-range. The calibration reference must be measured within 10% of it's true value for the curve to be considered valid.

Sample Preparation - Preserved samples are digested with blanks, calibration standards, and quality control samples. Samples are filtered post digestion if turbid. Samples are digested in accordance with EPA Method 365.4.

Analytical Measurement - Refer to AMS document #TSC-430-L-PR-019, "Basic Operation, Maintenance and troubleshooting of the Alpkem Automated Anion Analyzer, (Perstorp Model 3590)

Procedure -
-Set up manifold and set heater to 37°C
-Add all reagents except molybdate/antimony
-Obtain a stable baseline
-Add the molybdate/antimony and obtain a stable baseline
-Construct calibration curve
-Analyze samples in accordance with analytical measurement section of this document.

Data Treatment - A computer data printout is obtained from the Alpkem 3590 system. This includes calibration curves, correlation coefficients, concentrations and associated intensities. Data is logged out on the LIMS system. A hard copy of the data is kept on file with the analysts copy of the report.

Data Deliverables - Standard data deliverables include sample date, date of analyses, method of analysis and the analysts initials. Date of sample receipt is noted in the reporting cover letter. Data deliverables may or may not include quality control summaries and/or raw data, dependent upon the clients request.

Quality Control Requirements - The quality control includes; 1) the following four QC samples - Preparation Blank, Duplicate, Matrix Spike and Laboratory

Control Sample and 2) the following run QC; initial and continuing calibration verifications, initial and continuing calibration blanks.

The following table summarizes quality control limits and frequency requirements.

QUALITY CONTROL SAMPLES	FREQUENCY	LIMITS
Prep Blanks	1 per batch of 20 or less	< PQL (Practical Quantitation Limit)
Laboratory Control Sample	1 per batch of 20 or less	80-120%
Duplicate	1 per batch of 20 or less	20% RPD, if <5 X PQL
Spike	1 per batch of 20 or less	75-125%
Initial Calibration Verification	after every calibration	90-110%
Initial Calibration Blank	after every calibration	< PQL
Continuing Calibration Verification	10%	90-110%
Continuing Calibration Blanks	10%	< PQL

References - Enviroflow 3500 Technical Information
Perstorp Operators Manual.
The Flow Solution Operation Manual - Alpkem/Perstorp
Analytical SoftPac (tm) Plus Manual-Perstorp Analytical
EPA Method 365.1
AMS Document #TSC-430-L-PR-019, "Basic Operation, Maintenance and Troubleshooting of the Alpkem

Automated Anion Analyzer (Perstorp Model 3590).

Method Validation Data -Refer to EPA Method 365.4 of Methods for Chemical Analysis of Water and Wastes.